DOCUMENT RESUME

ED 179 803 CE 023 573

TITLE	Plans for Learning Stations. Tractor Mechanics.
INSTITUTION	Clemson Univ., S.C. Vocational Education Media Center.
SPONS AGENCY	South Carolina State Dept. of Education, Columbia. Office of Vocational Education.: South Carolina State Dept. of Education, Columbia. Vocational Agriculture Section.
PUB DATE	79
NOTE	96p.
EDRS PRICE	MF01/PC04 Plus Postage.
DESCRIPTORS	*Agricultural Engineering; *Auto Mechanics (Occupation); Learning Modules; Machine Repairmen; *School Shops; *Tractors; *Trade and Industrial Education; Training Laboratories

ABSTRACT

This shop guide gives graphic illustration of twenty-eight learning stations in a tractor mechanics shop, at each of which a specific learning activity occurs. The authors suggest that each station (most of them constructed of plywood or sheet metal and angle iron) be self-contained, having its own appropriate tools, supplies, parts, and set of instructions so that students may proceed at their own pace with minimal supervision. Each learning station description covers use (e.g., to polarize the generator, replace the rear ark, or measure piston ring clearance), special instructions to the teacher, tools and supplies needed, and simulator materials. Subject areas covered include electrical (battery, alternator, generator, starter, spark plugs, and ignition), fuel system (carburetor, fuel pump, injectors, and filters), cooling system, bearings and mechanicals (seals, bearings, gaskets, and clutch), and main engine block parts (pistons, valves and assemblies, connecting rods, crankshaft, and timing gear). (CP)

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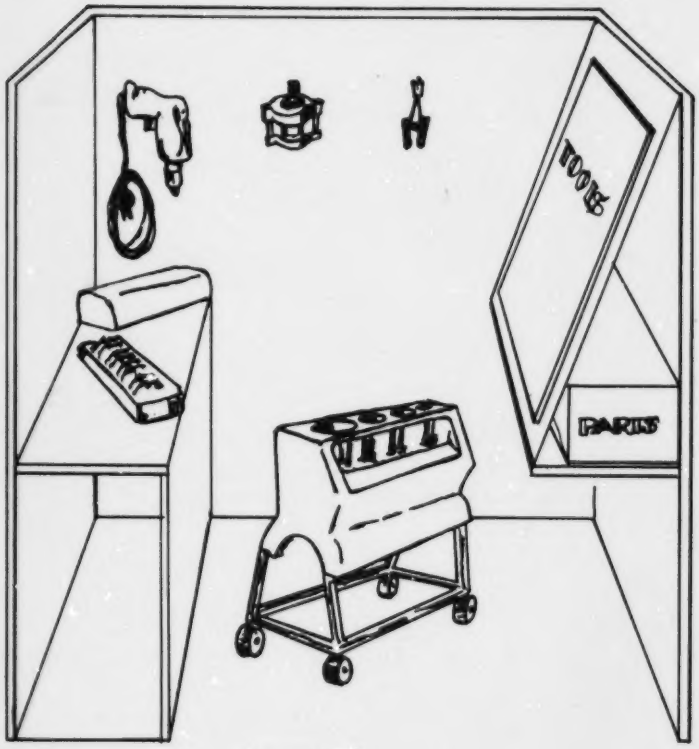
PLANS FOR LEARNING STATIONS

TRACTOR MECHANICS



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PURPOSE OF THIS PUBLICATION

The learning station suggestions presented in this publication are the results of considerable study and evaluation of the Tractor Mechanics modules which you have received. The learning stations are carefully planned centers at which students can perform a number of performance activities within your shop without having "live" tractors available for every individual student or team of students. The stations can be used over and over for the repetition of these activities. All tools and equipment are readily available. The station is compact and keeps materials in a neat, orderly manner.

The appropriate learning activity package number or numbers applicable to each station can be found on each learning station description page.

These stations were designed by:

Mr. Ray T. Johnson
Colleton AVC

Mr. William A. Whitfield
Saluda High School

Mr. Jack P. Corn
Laurens District 55 AVC

Their cooperation and careful thought concerning these centers is gratefully acknowledged.

Most of the stations can be constructed of plywood or sheet metal and angle iron. Sizes are not specifically given as the equipment may vary from shop to shop. Make the work area comfortable in height and size for your students.

Although it may be necessary for students to occasionally obtain tools from a central tool room, it is recommended that, when feasible, tools needed at each station be kept at that station permanently. Tools should perhaps be boxed or placed in special wall panels. The boxes should be labeled by station if there is a need to lock the tools in a central tool room.

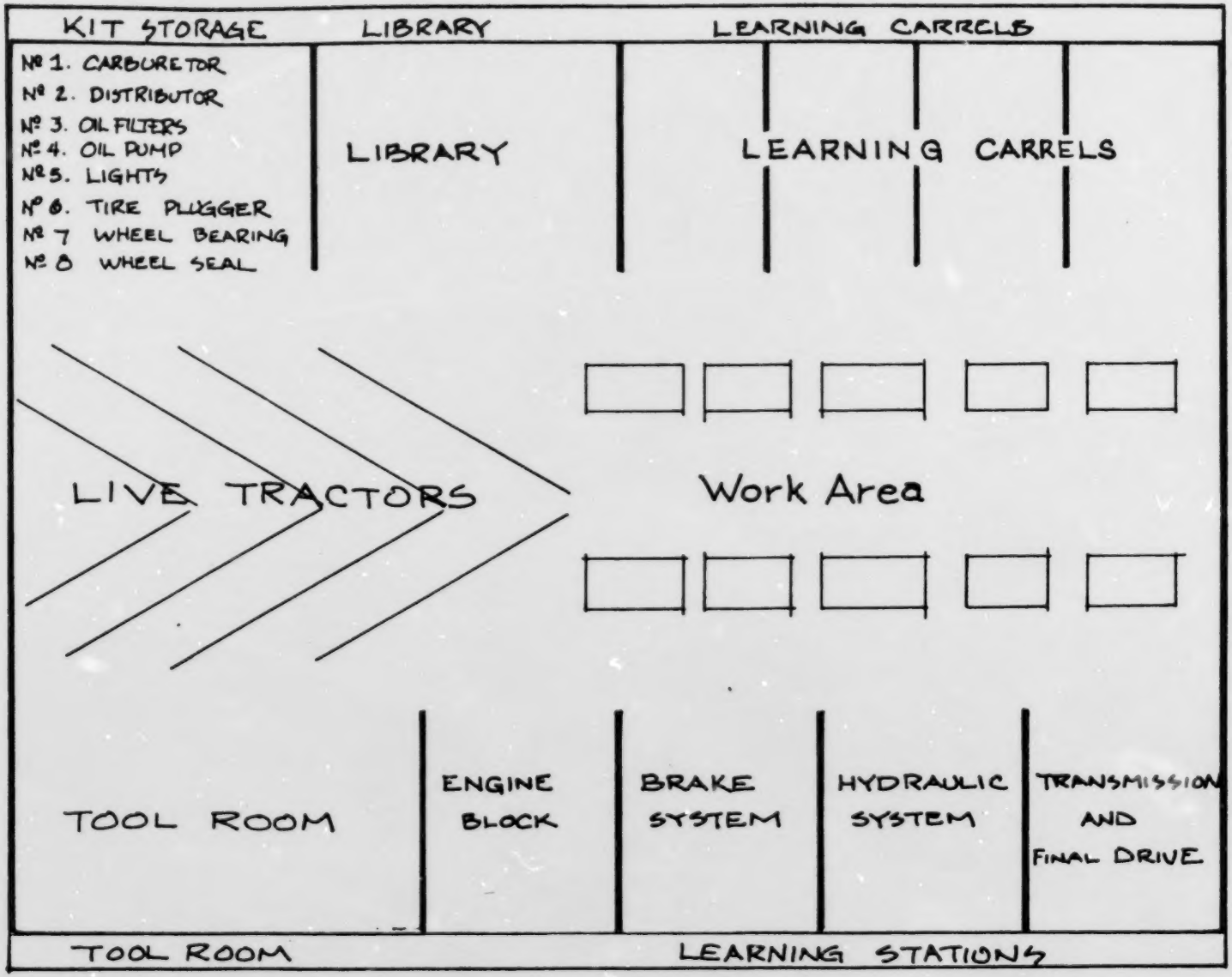
The tractor components or simulators used should, of course, provide as much reality as is feasible. However, it is not intended that they will provide the degree of reality which could be attained by using a live tractor with a real mechanical problem. Also, the student will not always receive the experience of disassembly frequently necessary to reach the part or component to be serviced. For example, servicing the rings on a tractor would ordinarily require the student to remove the head, pan, and other components necessary to reach the pistons. The learning stations will usually not provide these types of experiences but will instead go directly to the more specific task of removing old rings, cleaning ring grooves, and installing new rings. Perhaps, ideally, these more specific tasks should be scheduled first at learning stations. Later, perhaps in the second year of tractor mechanics or the latter half of the first year, "live jobs" should be scheduled which would involve more general troubleshooting and disassembly-type experience.

The instructor should feel free to modify these stations in anyway needed when the components are not available as shown. Old tractor components are difficult to find and sometimes expensive. Automotive parts may in some cases, be substituted. New tractor parts are, of course, more desirable, even necessary, if the operational concepts are different. For example, electronic or solid state ignition systems may be necessary if tractor manufacturers install such systems. If modifications are made, the instructor should make sure that these changes do not violate the intent of the objective as stated in the learning activity package relevant to the task.

Ideally, the shop layout might be as shown in the layout suggested here. (See page iii) Note that there is an area for kit storage as well as an area for learning stations. Some of the smaller components might best be put up as kits and stored in boxes. The student would then take the kit to any one of the work benches to perform the task indicated in the learning activity package. After use, the kit could be returned to storage.

In summary, this committee has developed plans for developing learning stations for selected tractor mechanics

learning activity packages. Other learning activity packages may require "live" tractors while others may be facilitated by the use of kits. It is not the intention of the committee to suggest that all learning activity packages should be performed at permanent learning stations nor does the committee suggest that "live" projects or other forms of instruction should not be used. It is an attempt to encourage the development of learning stations to accompany selected learning activity packages in hopes that this will facilitate or expedite learning by expanding opportunities for individualized instruction and by reducing the necessity of having "live" tractors.



(D) LEARNING LAB IN A SHOP (AG. MECHANICS)

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TRACTOR MECHANICS LEARNING STATION NO. 1

LEARNING ACTIVITY PACKAGE NO. 3

Testing the Battery

Description of Use

This kit can be used to enable the student to test a battery:

1. using a hydrometer
2. using a starter
3. using a load testing machine
4. using a combination of methods 1 and 2 or 1 and 3

Special Instructions to the Teacher

If a load tester is to be used, a "live" tractor will be needed.

Tools Needed

1. hydrometer
2. voltmeter
3. load tester
4. filler can
5. gravity chart
6. goggles

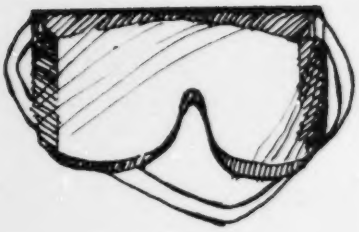
Supplies Needed

1. soda
2. water

Simulator Materials

battery

TOOLS/EQUIPMENT/SUPPLIES



GOGGLES

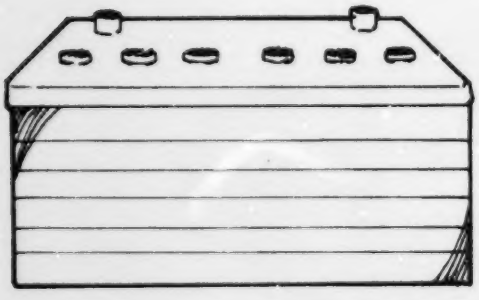
SODA

HYDROMETER

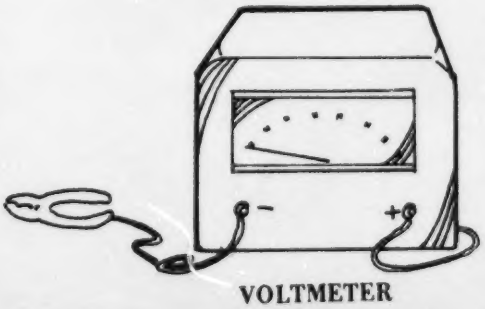
GRAVITY CHART

FILLER CAN

LOAD TESTER



BATTERY



VOLTMETER

STATION 1 (testing the battery)

TRACTOR MECHANICS LEARNING STATION NO. 2

LEARNING ACTIVITY PACKAGES

Testing the Charging Circuit No. 7

Adjusting the Voltage Regulator No. 8

Description of Use

This kit can be used to enable students to:

1. polarize the generator
2. test the generator
3. test the alternator
4. adjust the voltage regulator using the fixed resistance method
5. adjust the voltage regulator using the variable resistance method

Special Instructions to the Teacher

If skid units or live tractors are available in sufficient quantity this kit may not be needed.

Tools Needed

1. pliers
2. screwdriver
3. open-end wrench set
4. growler
5. ammeter
6. voltmeter
7. carbon pile resistor (lamp or motor)
8. switch

Supplies Needed

wire (no. 14 gauge) (to make hook ups)

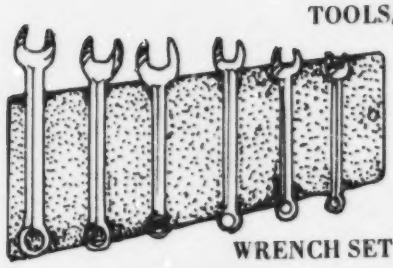
Simulator Materials

1. battery
2. generator
3. alternator
4. voltage regulator
5. ammeter
6. carbon pile resistor (head lamp or motor can be substituted for this)
7. small electric motor (1725 rpm's)

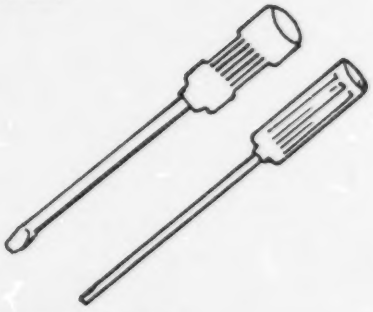
Sources of Materials for Simulator

salvage yards

TOOLS/EQUIPMENT/SUPPLIES

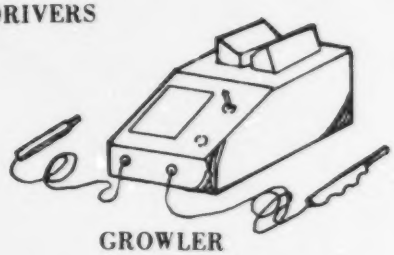


WRENCH SET



SCREWDRIVERS

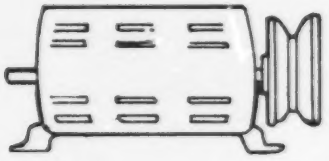
CARBON PILE RESISTOR



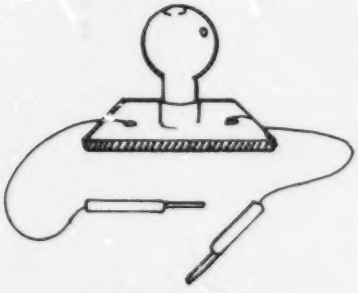
GROWLER

SWITCH

PLIERS

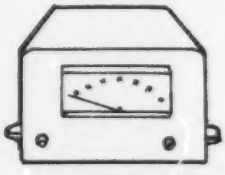


SMALL ELECTRIC MOTOR

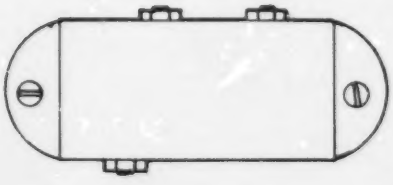


TEST LAMP

AMMETER

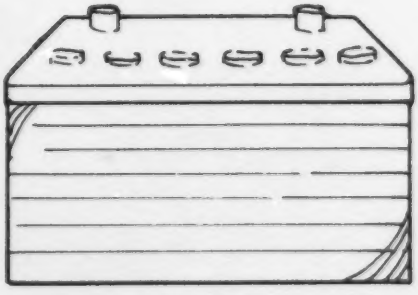


VOLTMETER

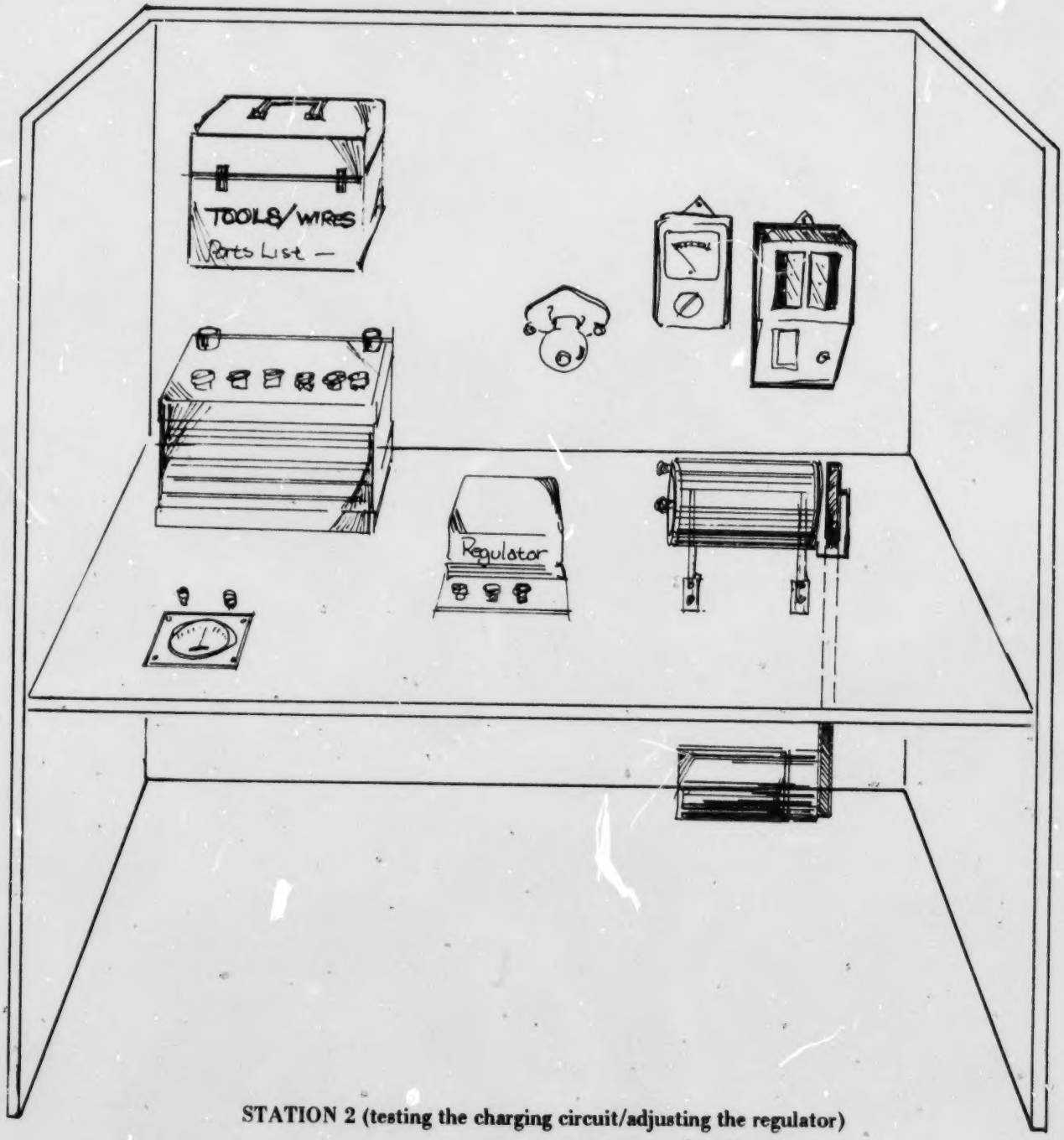


VOLTAGE REGULATOR

GENERATOR



BATTERY



STATION 2 (testing the charging circuit/adjusting the regulator)

TRACTOR MECHANICS LEARNING STATION NO. 3

LEARNING ACTIVITY PACKAGE NO. 9

Servicing the Alternator

Description of Use

This kit can be used to enable students to:

1. test the alternator regulator
2. test the alternator diode
3. replace an alternator diode
4. replace an alternator heat sink

Special Instructions to the Instructor

Additional diodes and heat sinks will be needed for testing. Both good and defective heat sinks and diodes will be needed.

Tools Needed

1. pliers, regular
2. plier, needle nose
3. 1.5 ohmmeter
4. press
5. soldering iron
6. open-end wrench set
7. hammer
8. pulley puller
9. test lamp

Supplies Needed

1. solder
2. heat sinks (good and defective)
3. diode (good and defective)

Simulator Materials

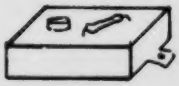
1. alternator
2. alternator regulator

Sources of Simulator Materials

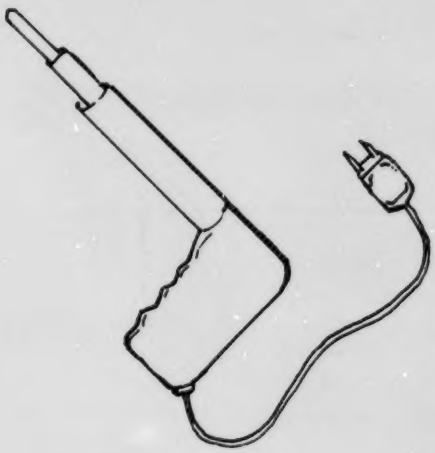
local salvage yard

TOOLS/EQUIPMENT/SUPPLIES

NEEDLE NOSE PLIERS

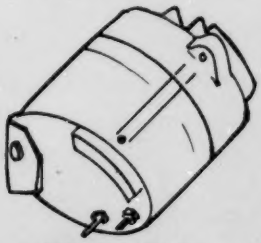


REGULATOR



SOLDERING IRON

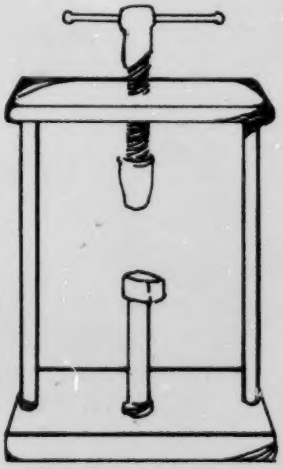
HAMMER



ALTERNATOR

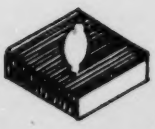
PULLEY PULLER

SOLDER



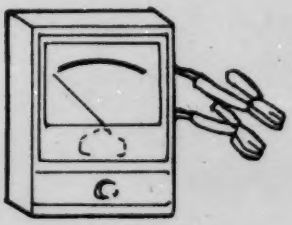
PRESS

PLIERS

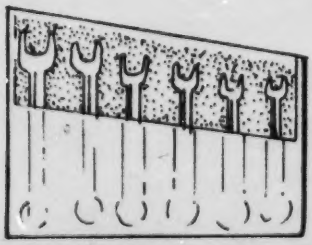


HEAT SINK

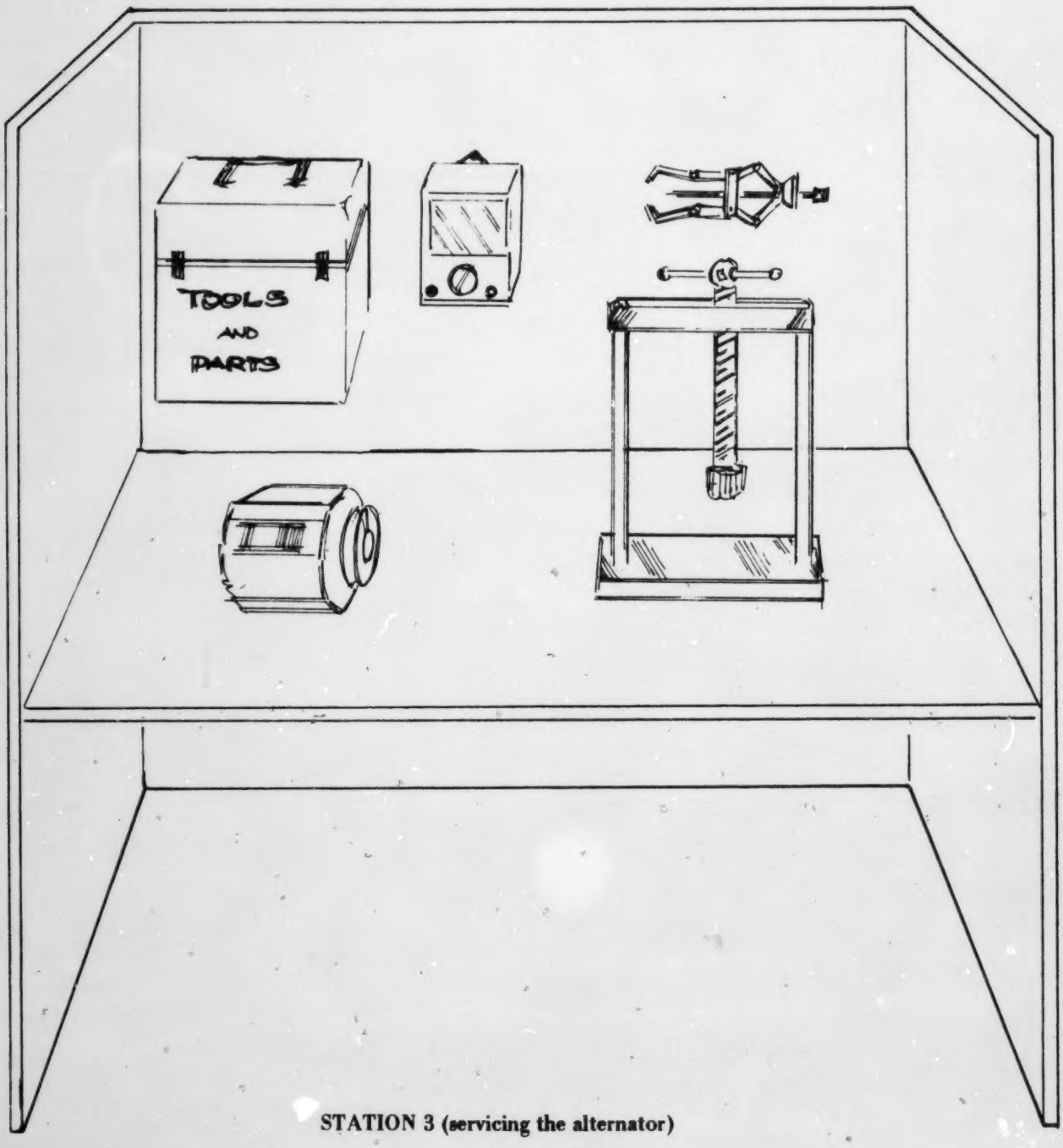
DIODE



OHMMETER



OPEN-END WRENCH SET



STATION 3 (servicing the alternator)

TRACTOR MECHANICS LEARNING STATION NO. 4

LEARNING ACTIVITY PACKAGE NO. 10

Servicing the Generator

Description of Use

This kit can be used to enable the student to:

1. polarize the generator* (See Learning Station 2)
2. replace the generator brushes
3. replace generator bearings

Special instructions to the Teacher

Since it would be expensive to supply brushes and bearings to be replaced by each student, each student would be required to remove and then replace the same brushes and bearings. The same armature could be turned for a limited number of times and would then have to be replaced.

Tools Needed

1. screwdriver
2. pliers
3. wrenches (open-end)
4. wrenches (ignition)
5. arbor press
6. micrometer
7. armature turning tool
8. buck seat stone

Supplies Needed

1. ignition wire
2. sandpaper (no. 00)
3. replacement bearings
4. replacement brushes
5. replace armatures

Simulator Materials

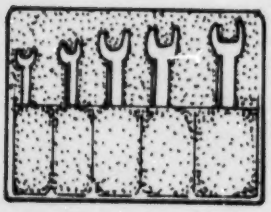
generator

Source of Simulator Materials

local salvage yard

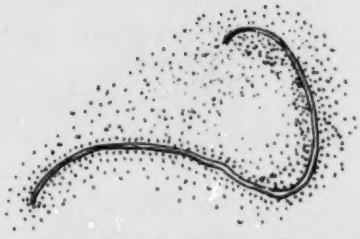
*This activity requires a battery and voltage regulator which have been included. You will perform this activity when you use Learning station 2, if you have not already done so.

TOOLS/EQUIPMENT/SUPPLIES

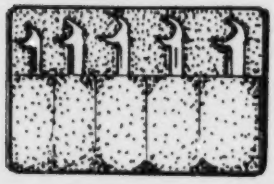


WRENCHES (OPEN-END)

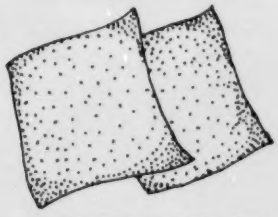
MICROMETER



IGNITION WIRE

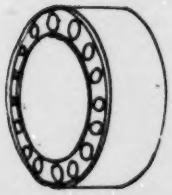


WRENCHES (IGNITION)

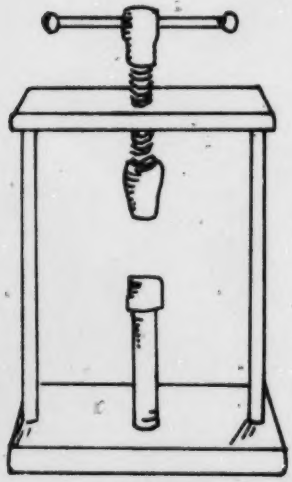


SANDPAPER (NO. 00)

PLIERS

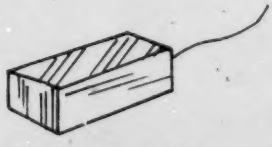


REPLACEMENT BEARINGS

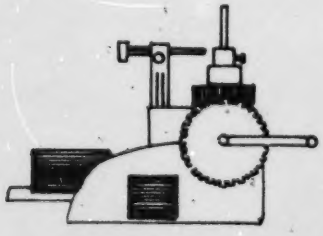


PRESS

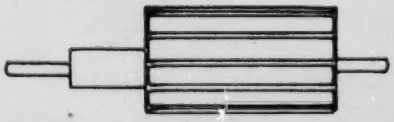
SCREWDRIVER



REPLACEMENT BRUSHES



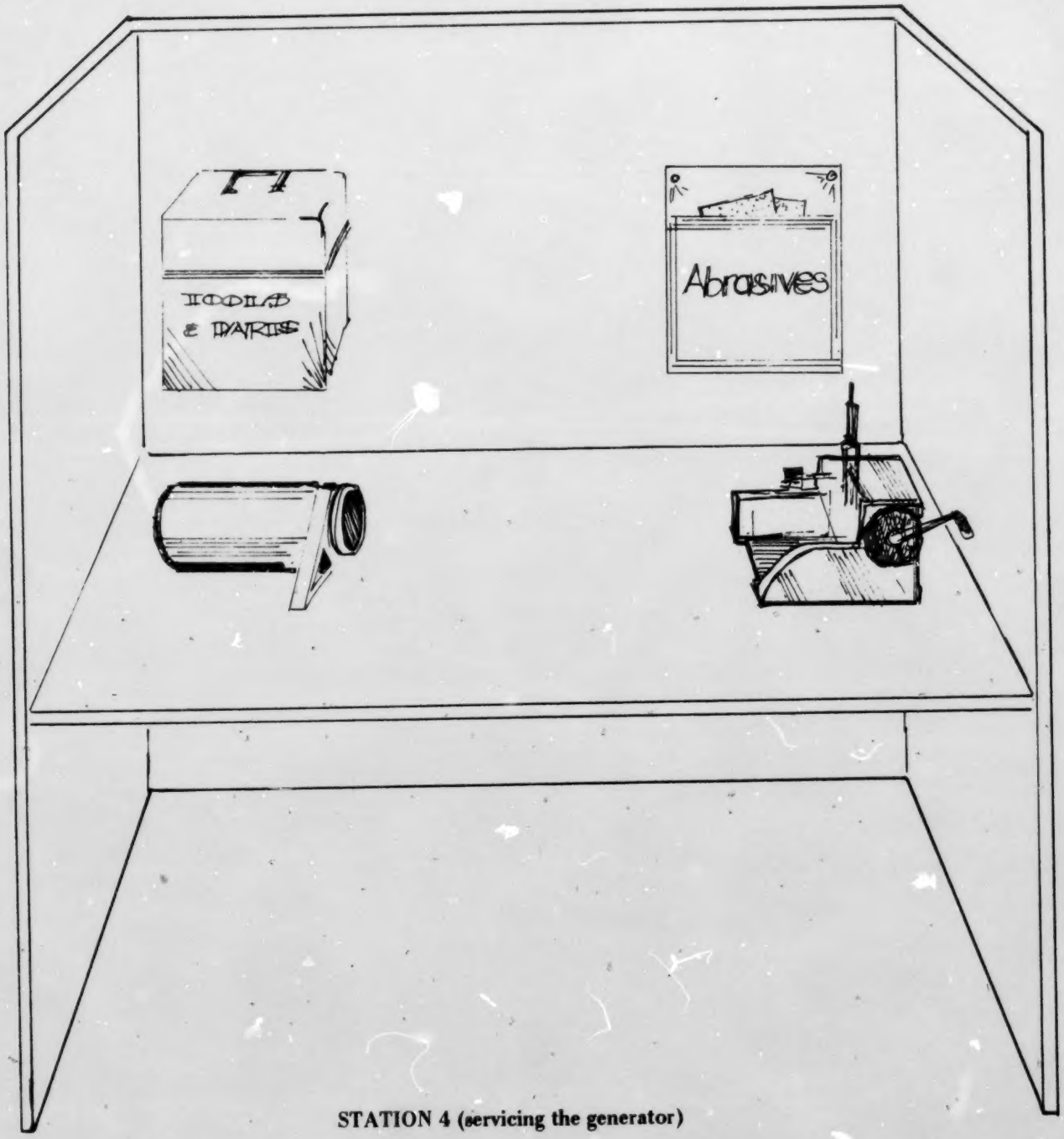
ARMATURE TURNING TOOL



ARMATURE

SEAT STONE

GENERATOR



STATION 4 (servicing the generator)

TRACTOR MECHANICS LEARNING STATION NO. 5

LEARNING ACTIVITY PACKAGE NO. 11

Replacing an Amperage Gauge

Description of Use

This kit can be used to enable the student to replace an amperage gauge.

Special Instructions to the Teacher

If skid units or live tractors are available this kit may not be necessary.

Tools Needed

Screwdriver

Supplies Needed

Amperage gauge

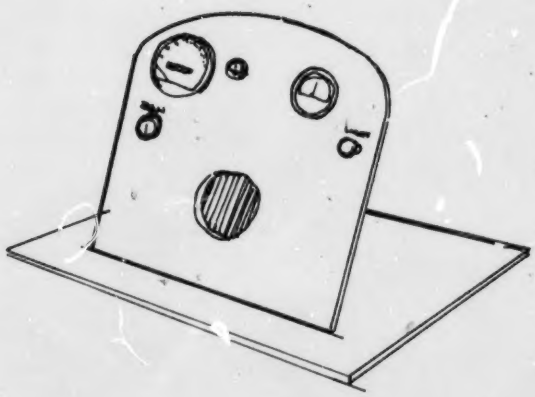
Simulator Supplies

Cardboard or plywood panel poster of a typical panel

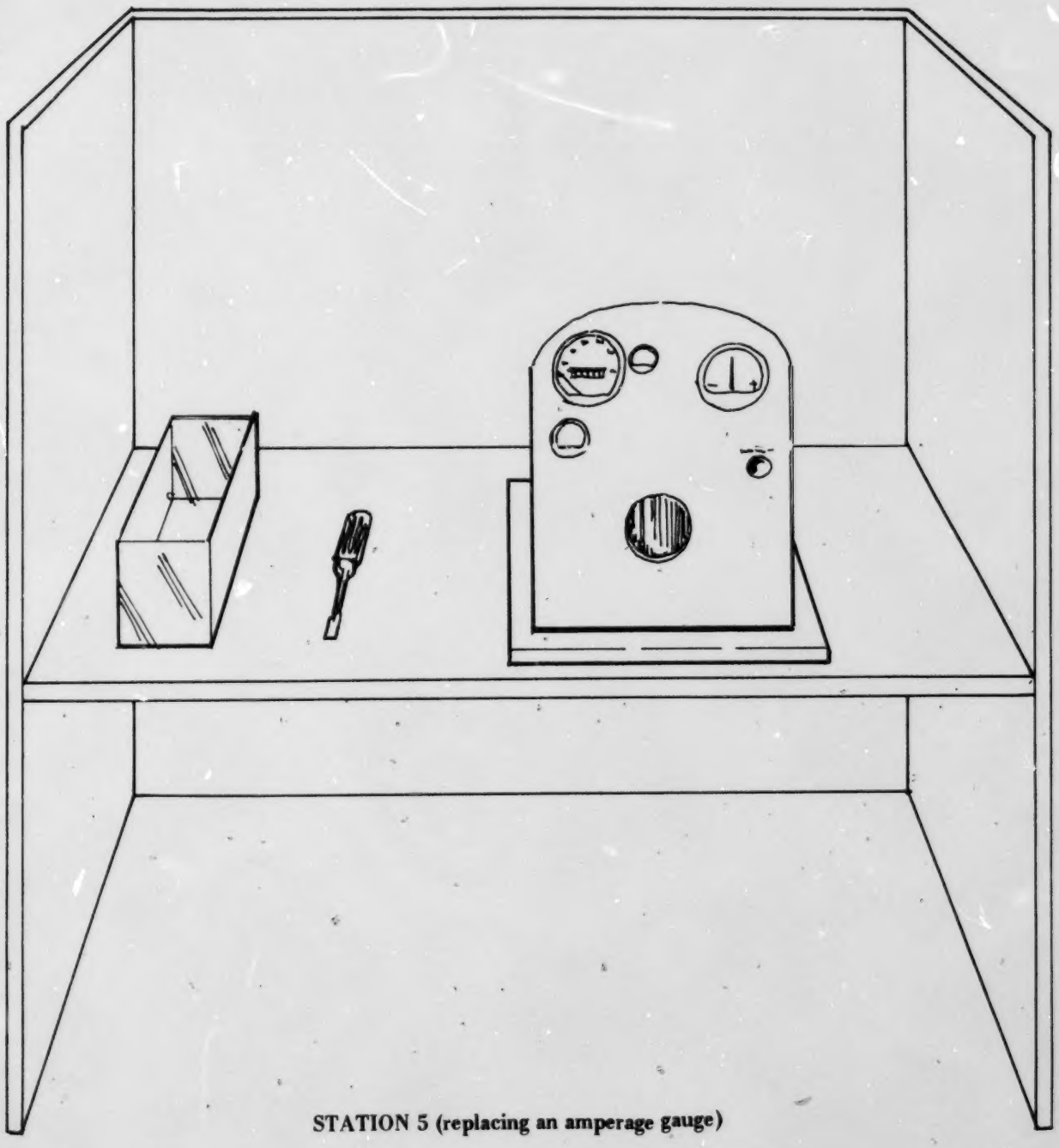
TOOLS/EQUIPMENT/SUPPLIES

AMPERAGE GAUGE

A TYPICAL PANEL



21



STATION 5 (replacing an amperage gauge)

TRACTOR MECHANICS LEARNING STATION NO. 6

LEARNING ACTIVITY PACKAGES NO. 12 and 15

Servicing the Distributor
Servicing the Ignition Wires

Description of Use

This kit can be used to enable students to:

1. check the condition of a distributor
2. replace points
3. replace condenser
4. Set breaker points
5. Measure resistance of an ignition wire
6. replace ignition wires
7. replace secondary ignition wire
8. simulate timing

Special Instructions to the Teacher

Students can remove and replace the same parts. An electric drill can be used to operate the distributor. A simulated flywheel can be made of wood to allow students practice setting time with a timing light.

Tools Needed

1. ignition wrench set
2. feeler gauge
3. ohmmeter
4. timing light

Supplies Needed

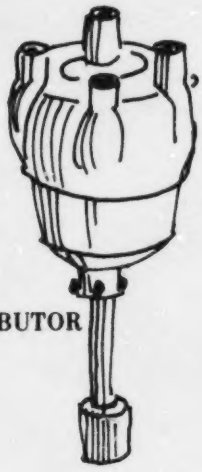
1. cleaning solvent
2. cleaning brush

Simulator Materials Needed

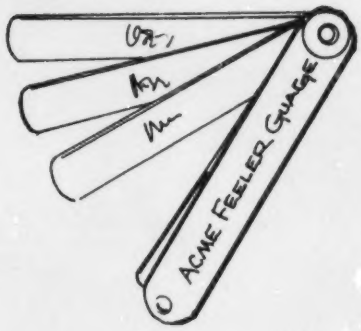
1. battery
2. electric drill (variable speed)
3. distributor
4. coil
5. switch
6. old engine head (optional)
7. plywood (½" x 12" x 12")
8. ignition wire and terminals

TOOLS/EQUIPMENT/SUPPLIES

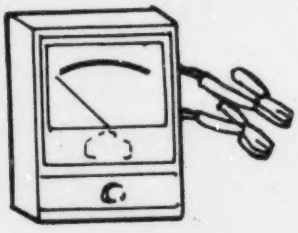
CLEANING SOLVENT AND BRUSH



DISTRIBUTOR

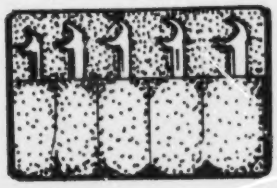


FEELER GAUGE

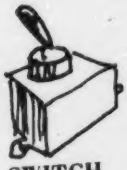


OHMMETER

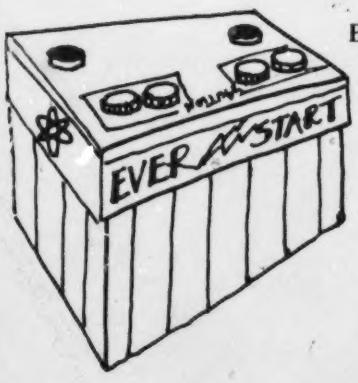
COIL



IGNITION WRENCH SET



SWITCH

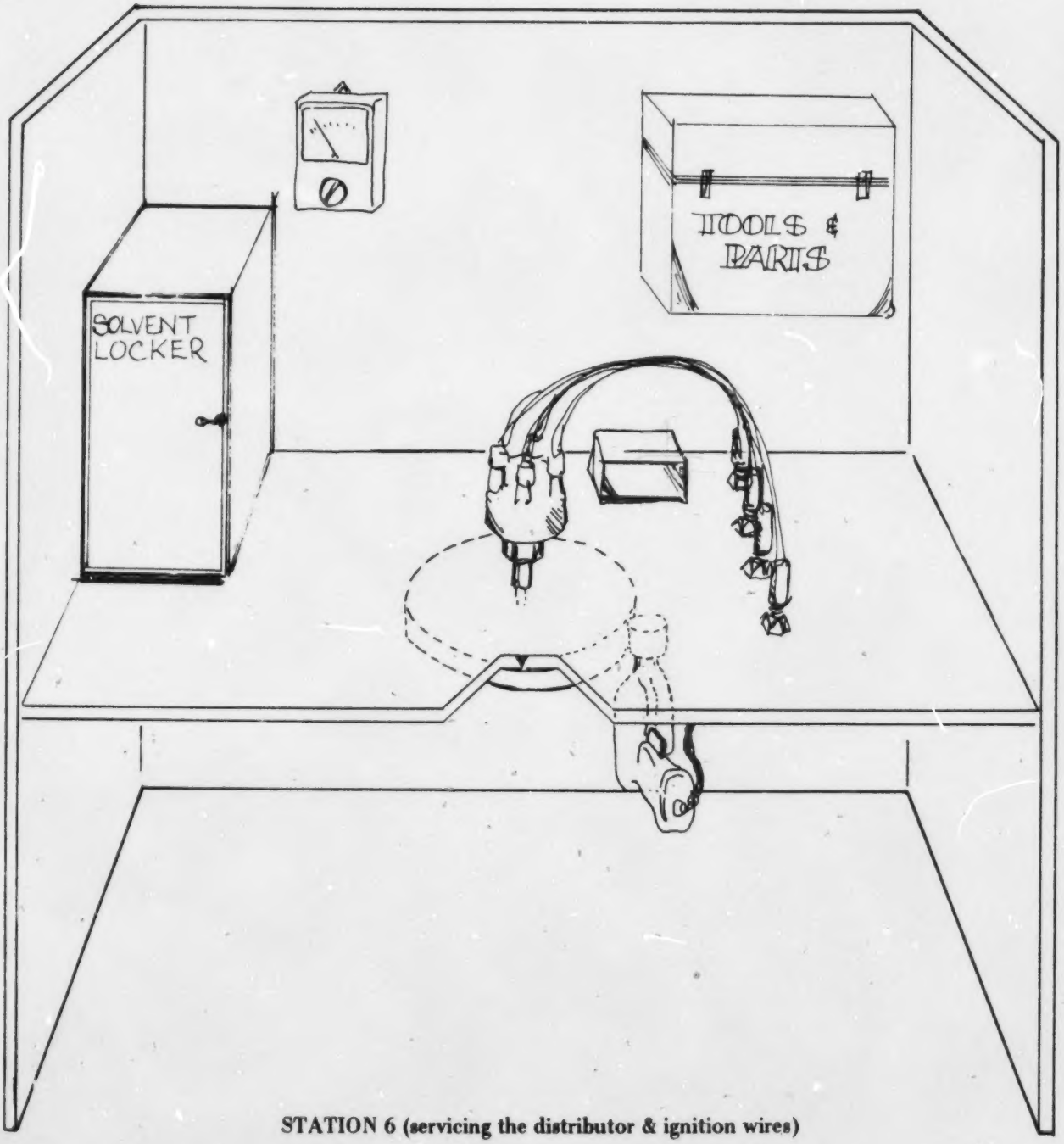


BATTERY

ELECTRIC DRILL

TIMING LIGHT

24



STATION 6 (servicing the distributor & ignition wires)

TRACTOR MECHANICS LEARNING STATION NO. 7

LEARNING ACTIVITY PACKAGE NO. 13

Servicing Spark Plugs

Description of Use

This kit can be used to enable the student to:

1. clean a spark plug
2. set the spark plug gap

Special Instructions to the Teacher

If a spark plug cleaner is not available the plug can be cleaned with a pocket knife and wire brush. If a sand blast spark plug cleaning machine is available, a learning station might be set up and the kit located in that vicinity.

Tools Needed

1. spark plug cleaner
2. spark plug wrench
3. spark plug gapper
4. spark plug gauges
5. wire brush
6. pocket knife
7. sand blast spark plug cleaner
8. torque wrench
9. ignition file

Supplies Needed

1. petroleum solvent
2. cleaning pan
3. cleaning rags

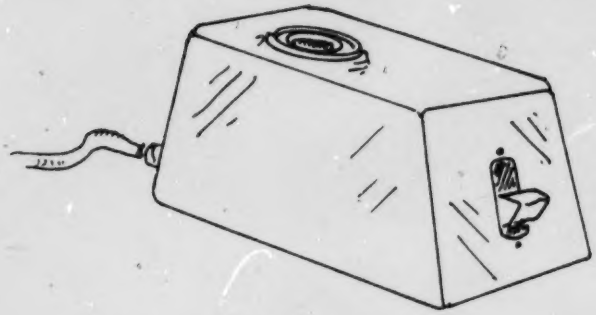
Simulator Materials

dirty spark plugs

Sources of Simulator Materials

local salvage yard

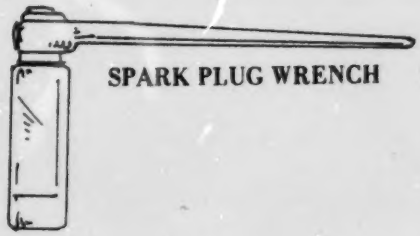
TOOLS/EQUIPMENT/SUPPLIES



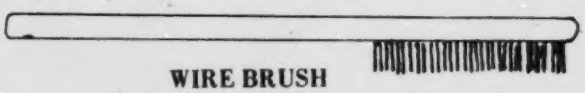
SPARK PLUG CLEANER

POCKET KNIFE

CLEANING PAN CLEANING RAGS



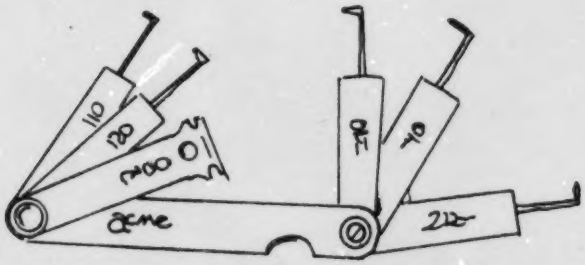
SPARK PLUG WRENCH



WIRE BRUSH

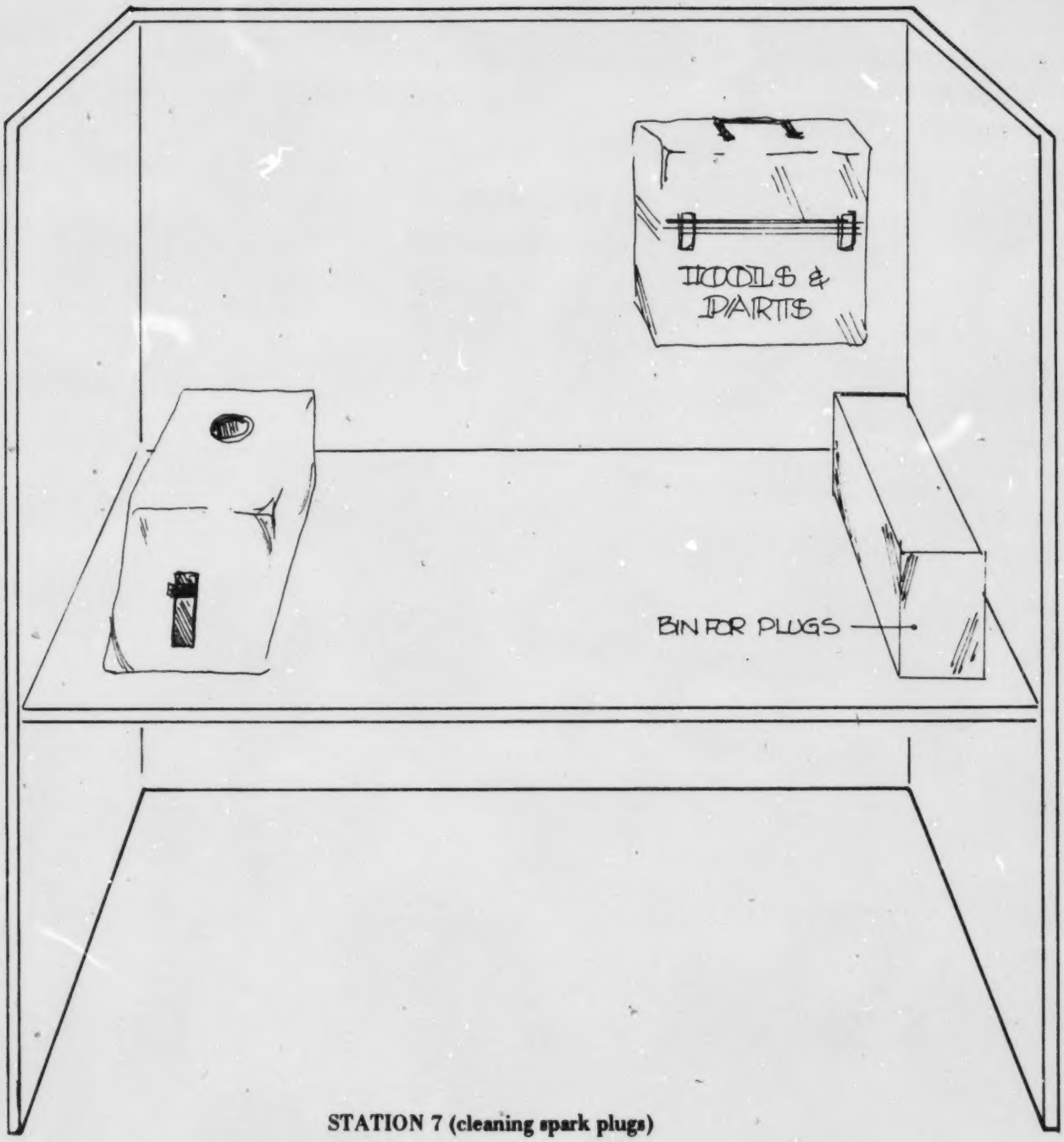
IGNITION FILE

TORQUE WRENCH



SPARK PLUG GAPPER

DIRTY SPARK PLUGS



STATION 7 (cleaning spark plugs)

TRACTOR MECHANICS LEARNING STATION NO. 8

LEARNING ACTIVITY PACKAGE NO. 16

Testing the Starting Circuit

Description of Use

This kit can be used to enable the student to:

1. check an ignition switch for continuity
2. check a safety switch
3. check a solenoid
4. check a starter armature
5. check a starter field winding

Special Instructions to the Teacher

Shorted on non-operative parts such as shorted armature and shorted field winding should be placed in the simulator so that the student learns to recognize such malfunctioning parts

Tools Needed

1. continuity tester or ohmmeter
2. D.C. voltmeter or multi-meter
3. armature tester (growler)
4. ammeter
5. tachometer

Supplies Needed

None

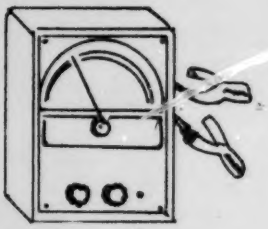
Simulator Materials

1. starter
2. battery
3. ignition switch
4. starter solenoid
5. starter winding (shorted)
6. starter armature (shorted)
7. starter solenoid (shorted)
8. starter switch (shorted)

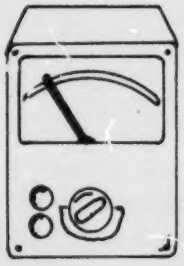
Sources of Simulator Materials

local salvage yard

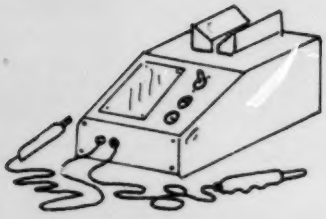
TOOLS/EQUIPMENT/SUPPLIES



OHMMETER

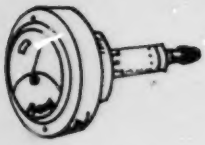


D.C. VOLTMETER

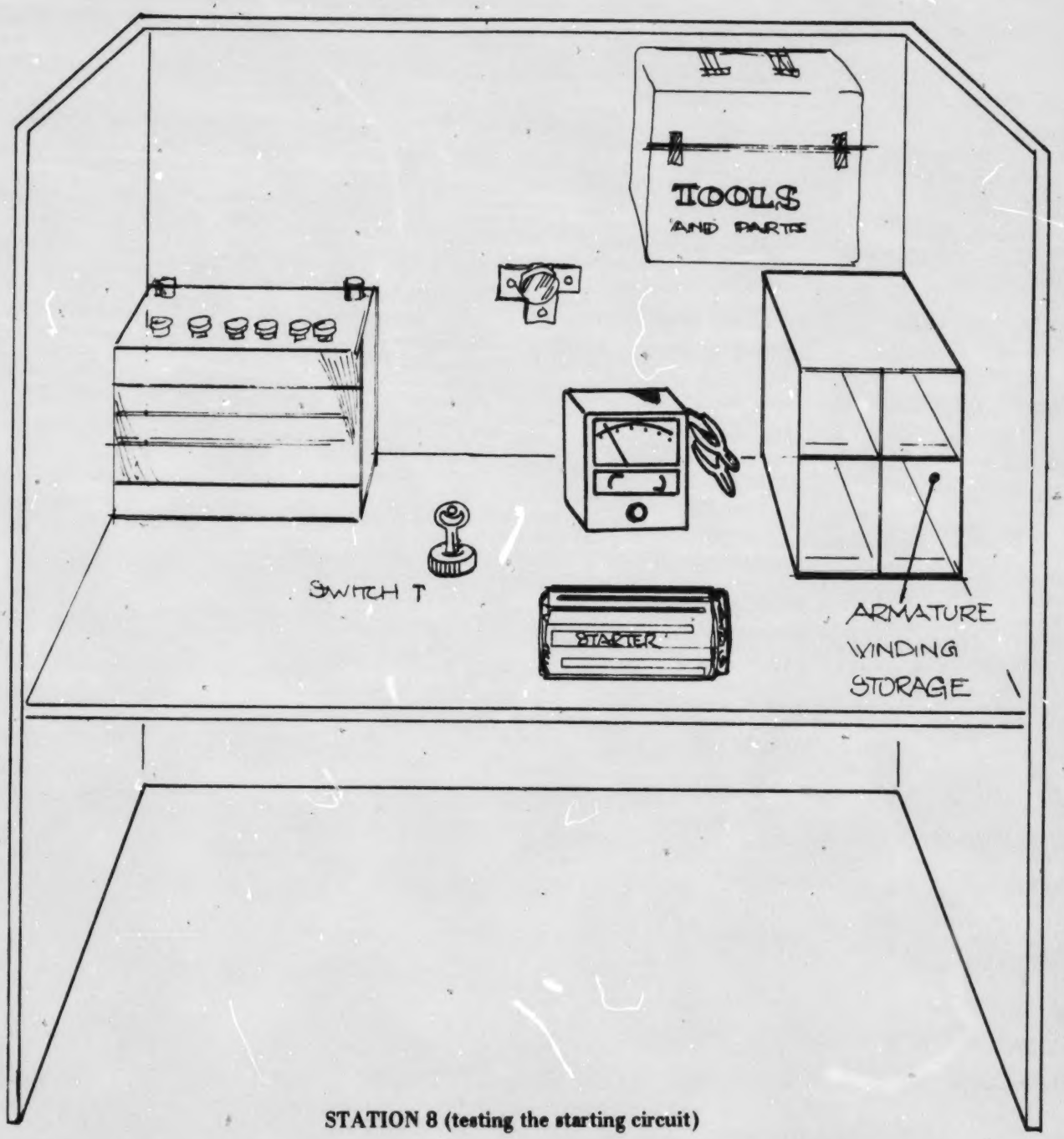


ARMATURE TESTER

AMMETER



TACHOMETER



STATION 8 (testing the starting circuit)

31

TRACTOR MECHANICS LEARNING STATION NO. 9

LEARNING ACTIVITY PACKAGE NO. 17

Servicing the Starter

Description of Use

This kit can be used to enable the student to:

1. replace a starter bearing
2. replace starter bushings
3. replace starter drive
4. replace starter solenoid

Special Instructions to the Teacher

Each student will be expected to remove and replace the components of the starter so that the next student can do the same.

Tools Needed

1. bearing puller
2. screwdriver
3. open end wrench set
4. hammer
5. pliers
6. bearing driver

Supplies Needed

bearing lubricant

Simulator Materials Needed

complete starter

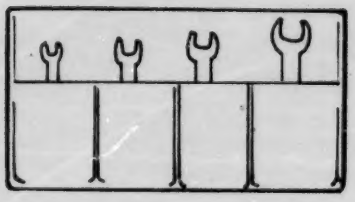
Sources of Simulator Materials

local salvage yard

TOOLS/EQUIPMENT/SUPPLIES

BEARING PULLER

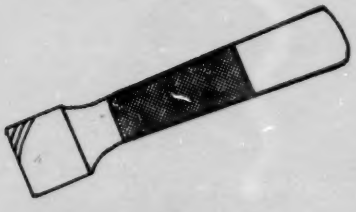
SCREWDRIVER



OPEN-END WRENCH SET

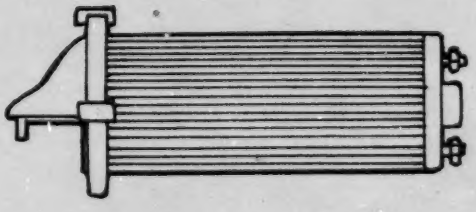
HAMMER

PLIERS

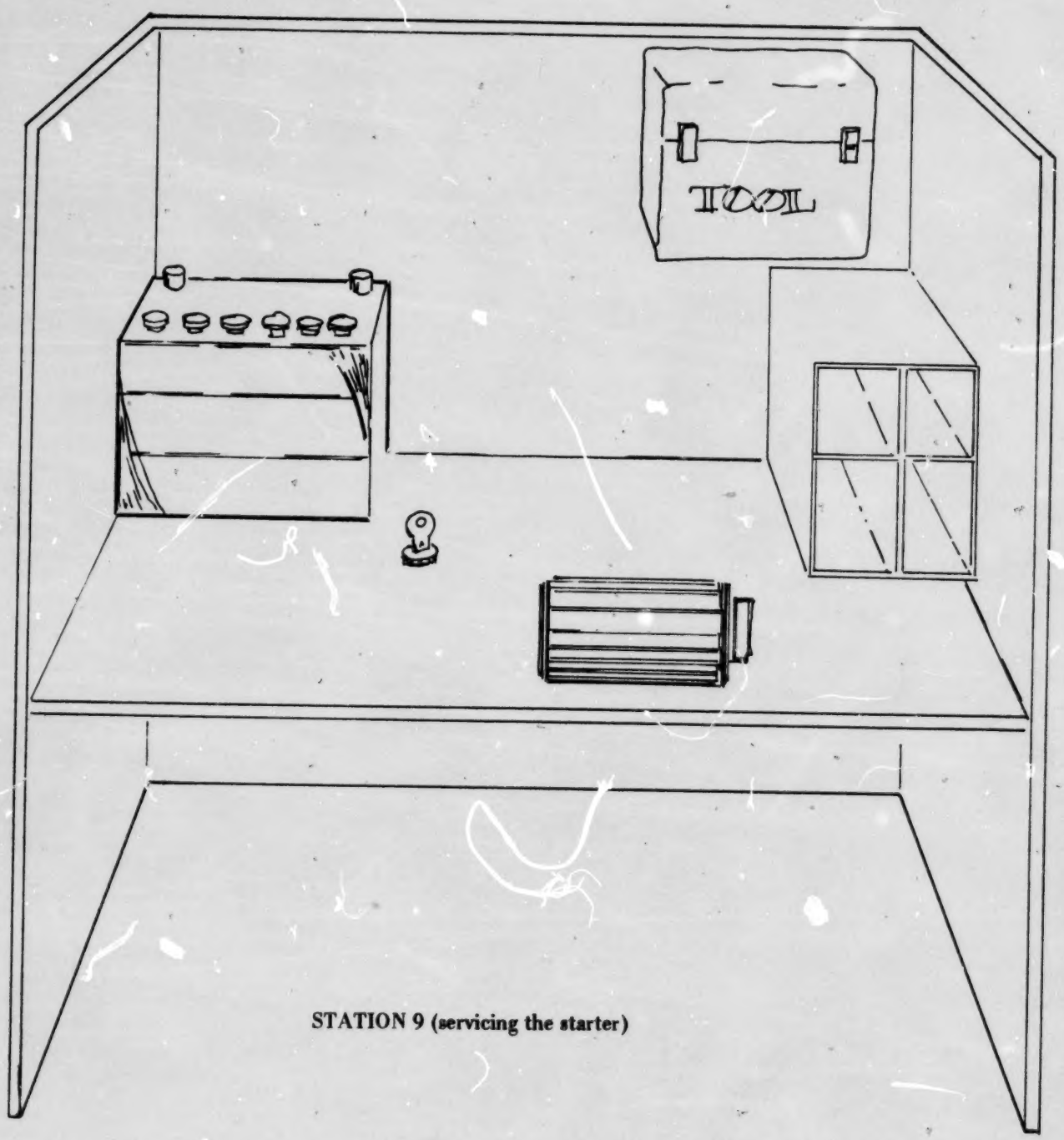


BEARING DRIVER

BEARING LUBRICANT



COMPLETE STARTER



STATION 9 (servicing the starter)

TRACTOR MECHANICS LEARNING STATION NO. 10

LEARNING ACTIVITY PACKAGE NO. 23

Servicing A Carburetor

Description of Use

This kit can be used to enable the student to:

1. clean the carburetor
2. adjust a carburetor float
3. install a carburetor repair kit

Special Instructions to the Teacher

Since carburetors are not expensive or large bulky items, it may be good to prepare more than one of these kits. This would provide for greater flexibility in scheduling.

At least one extra carburetor kit should be available, so that when the student disassembles the carburetor he/she will always be removing one kit and inserting another.

It may also be feasible to provide different types of carburetors in each kit.

Tools Needed

1. screwdriver
2. needle-nose pliers
3. open wrench set

Supplies Needed

1. carburetor cleaner
2. clean rags

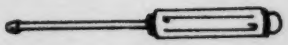
Simulator Materials Needed

1. carburetor
2. carburetor repair kit

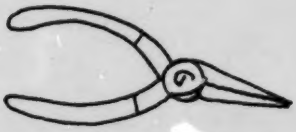
Sources of Simulator Materials

local salvage yard

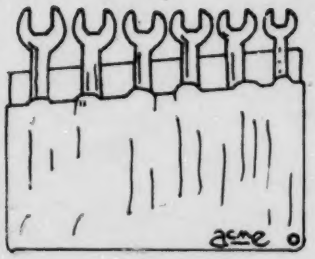
TOOLS/EQUIPMENT/SUPPLIES



SCREWDRIVER

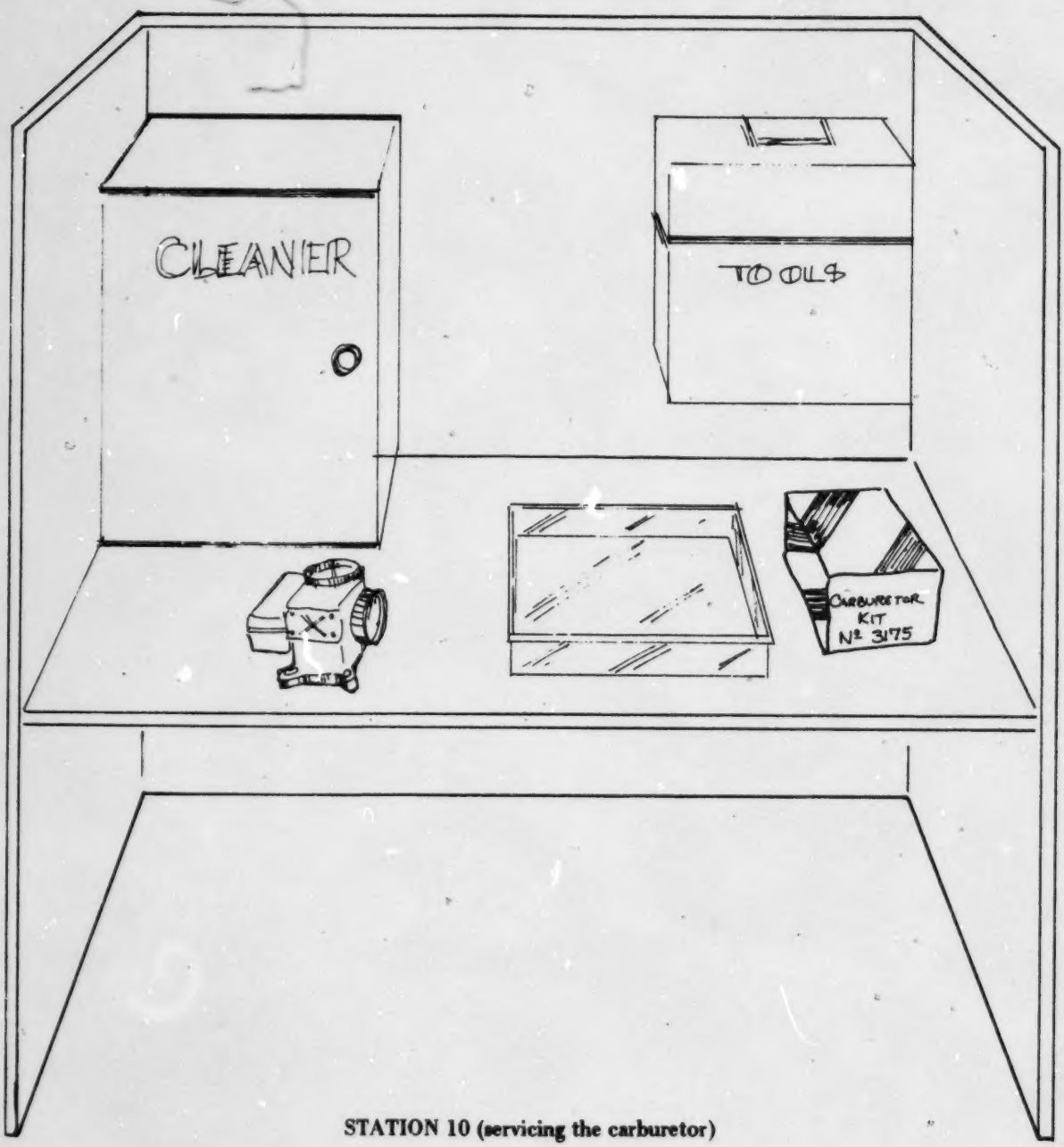


NEEDLE-NOSE PLIERS



OPEN-END WRENCH SET

CARBURETOR CLEANER AND RAGS



STATION 10 (servicing the carburetor)

TRACTOR MECHANICS LEARNING STATION NO. 11

LEARNING ACTIVITY PACKAGE NO. 26

Servicing the Fuel Pump

Description of Use

1. clean fuel pump components
2. check a fuel pump for pumping action
3. flare a fuel line
4. disassemble and reassemble a fuel pump

Special Instructions to the Teacher

Since a fuel pump will be really cleaned by the first student,each student who follows will be only simulating cleaning. However, since cleaning is very important, students should probably be required to simulate this task.

Extra fuel line will be needed to provide experience in flowing.

A variable speed drill or a very low rpm drill can be used to trigger the fuel pump to check pumping efficiency. Simply make a bend in a piece of heavy gauge wire or twenty penny nail and allow the cam action of the wire or nail to activate the pump plunger.

Tools Needed

1. open end wrenches
2. screwdriver
3. pliers
4. flare-nut wrench set
5. putty knife

Supplies Needed

1. fuel pump cleaner (carburetor cleaner)
2. gas line

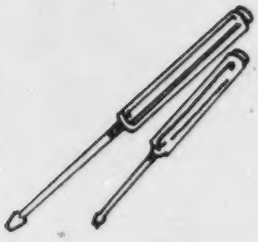
Simulator Materials Needed

1. two gas tanks (1 gallon gas cans will do)
2. fuel pump
3. electric drill

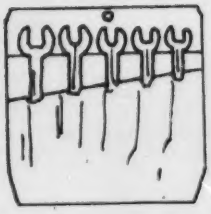
Sources of Simulator Materials

local salvage yard

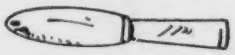
TOOLS/EQUIPMENT/SUPPLIES



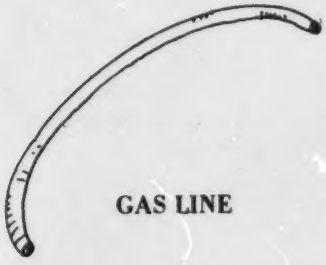
SCREWDRIVERS



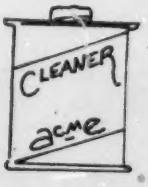
OPEN-END WRENCHES



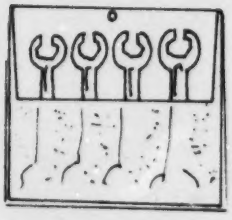
PUTTY KNIFE



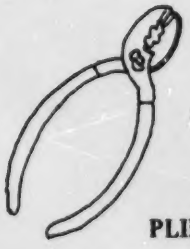
GAS LINE



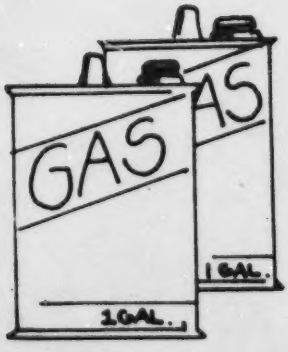
FUEL PUMP CLEANER
(CARBURETOR CLEANER)

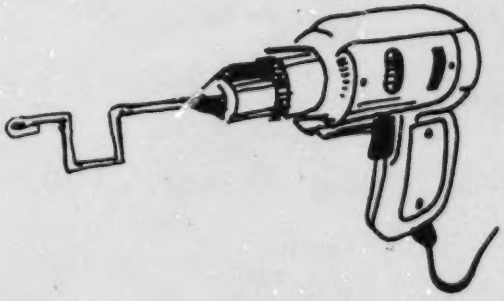


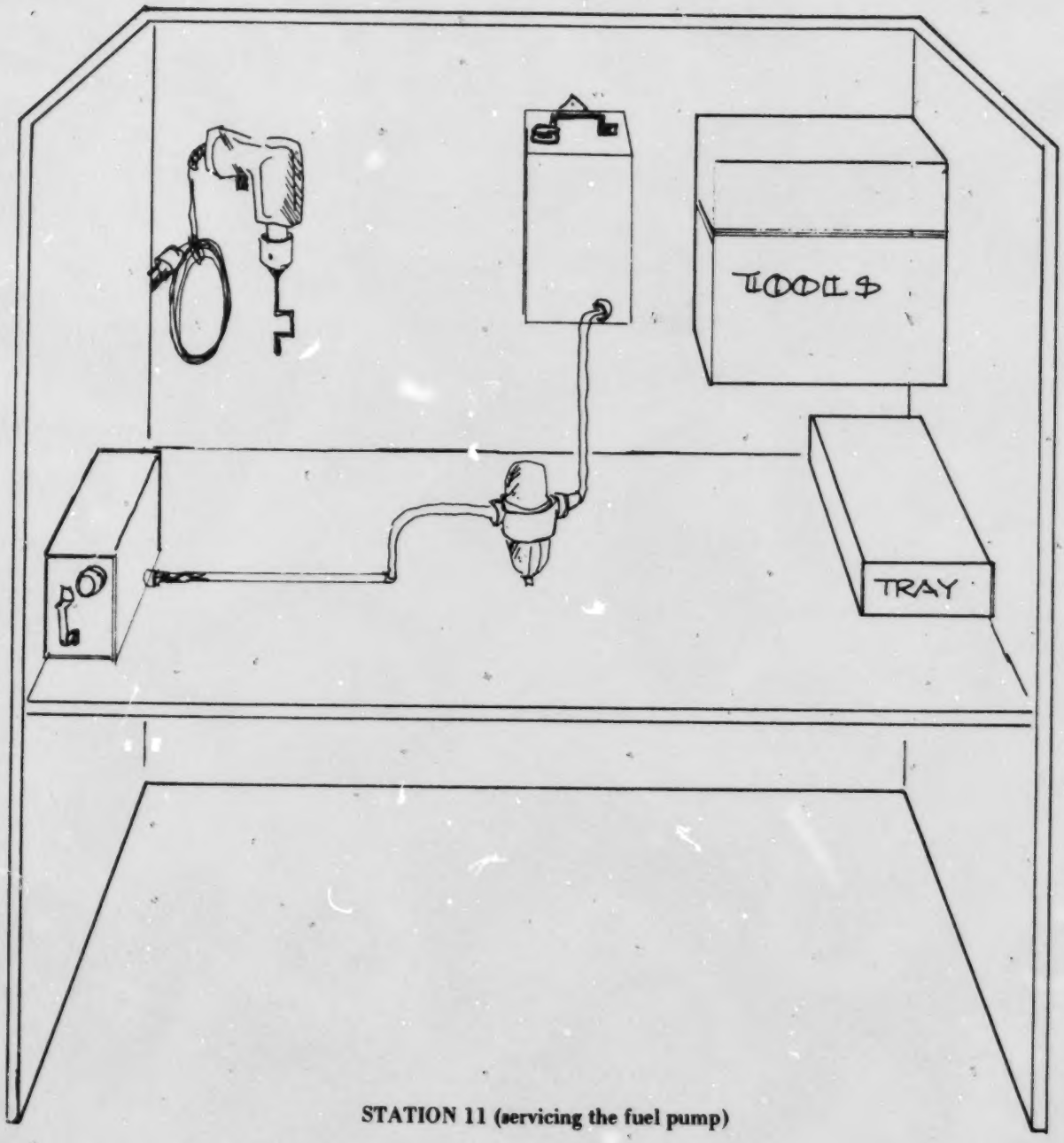
FLARE-NUT WRENCH SET



PLIERS







STATION 11 (servicing the fuel pump)

TRACTOR MECHANICS LEARNING STATION NO. 12

LEARNING ACTIVITY PACKAGE NO. 27

Servicing the Diesel Fuel Filters

Description of Use

This kit can be used to enable the student to:

1. disassemble and reassemble several types of diesel fuel filters
2. install a diesel fuel filter element
3. clean diesel fuel filters

Special Instructions to the Teacher

Assuming that all parts are clean after the first student has used the kit, the remaining students will have to simulate cleaning.

Several types of filters should be used. Extra filters could be provided to help simulate replacement.

Cleaning may be done in a special cleaning vat. When such equipment is not available the student may need to move to a suitable location where a drain is available.

It will probably not be feasible to set this simulator up with fuel oil under pressure. It may be practical to install the serviced filter on the live tractor as a final check if such equipment is available.

Tools Needed

1. open end wrenches
2. screwdrivers

Supplies Needed

1. carburetor cleaner
2. cleaning rags

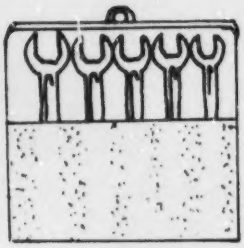
Simulator Materials Needed

different types of filters

Sources of Simulator Materials

local salvage yard

TOOLS/EQUIPMENT/SUPPLIES

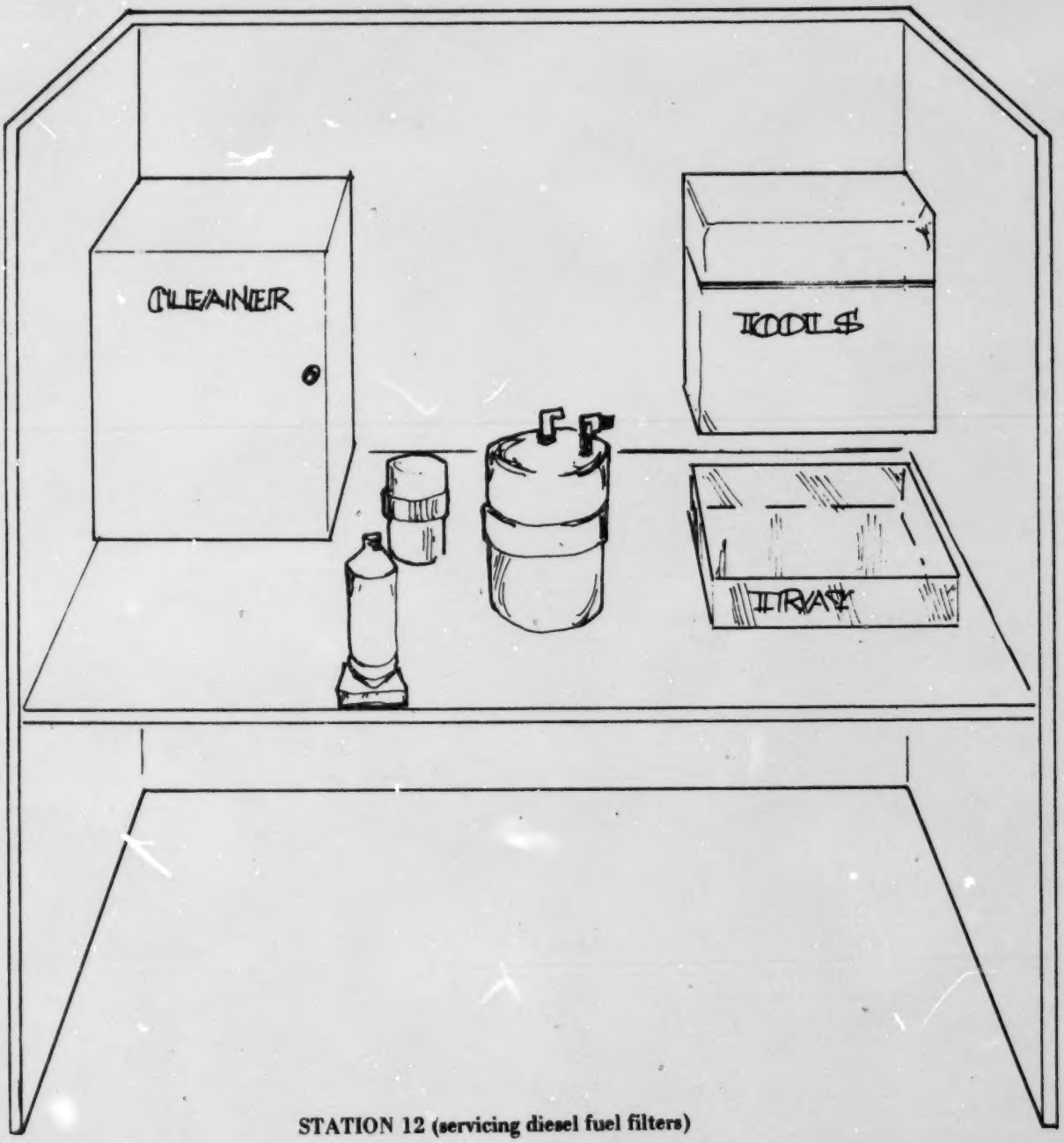


OPEN END WRENCHES

SCREWDRIVER

CARBURETOR CLEANER

CLEANING RAGS



STATION 12 (servicing diesel fuel filters)

TRACTOR MECHANICS LEARNING STATION NO. 13

LEARNING ACTIVITY PACKAGE NO. 30

Servicing a Diesel Fuel Injector

Description of Use

This kit can be used to enable the student to simulate:

1. removing an injector from an engine
2. cleaning an injector
3. removing carbon dam seal and sealing washer
4. removing carbon from tip
5. removing pressure adjusting screw, washer and spring
6. removing nozzle valve
7. cleaning slip opening
8. cleaning seats with tip scrape
9. removing carbon from soc hole
10. polishing guide
11. adjusting using nozzle tester
12. checking seat leakage
13. installing carbon dam seals
14. reinstalling a nozzle
15. testing using nozzle tester

Special Instructions to the Teacher

Students may view slide series – Servicing Diesel Injection Nozzles. The projector should be located at the station.

Tools Needed

1. rossa-master tool set
2. injector nozzle tester
3. open end wrench set
4. valve tip scraper
5. brass wire brush
6. soc hole drill

Supplies Needed

diesel fuel

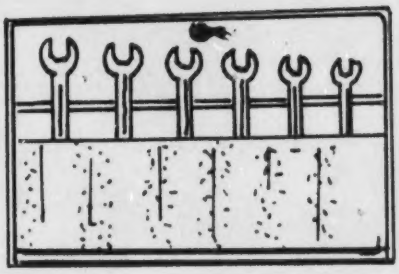
Simulator Materials Needed

1. engine head
2. injectors

Sources of Simulator Materials

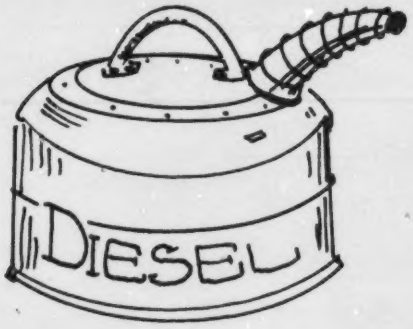
local salvage yard

ROSSA-MASTER TOOL SET



OPEN END WRENCH SET

BRASS WIRE BRUSH



DIESEL FUEL

NOZZLE TESTER

STATION 13 (servicing a diesel fuel injector)

TRACTOR MECHANICS LEARNING STATION NO. 14

LEARNING ACTIVITY PACKAGE NOS. 34, 35, 37, 38, 39, 40

Servicing the Cooling System

Description of Use

This kit can be used to enable the student to:

1. check coolant level
2. test cooling system pressure
3. service (test) a thermostat
4. replace a fan belt
5. replace a radiator hose
6. replace a water pump

Sources of Materials

Some of these materials will be available from local salvage yards--other items such as thermostats and hoses may require purchasing.

Special Instructions for the Teacher

If a tractor or skid unit is available for performing these tasks, they should of course be used. However, if these units are being used for other tasks, the competition for use may require that a simulator be constructed. You may wish to reserve the skid units or other operable equipment for tasks which require live equipment.

Tools Needed

1. radiator cap tester
2. hydrometer
3. hose clamp tool
4. pyrex beaker
5. thermometer
6. spring scales
7. 12" ruler
8. set of combination open-box end wrenches

Supplies Needed

1. radiator caps (2)
2. hoses (2)
3. thermostats (2)
4. gaskets (water pump) (20)
5. gasket sealer (2 tubes)
6. antifreeze (3 gallons)
7. hose clamps (6)
8. fan belts (2)

Simulator Components

1. radiator
2. generator pulley
3. crankcase pulley
4. water pump
5. thermostat housing
6. fan pulley

Simulator Materials

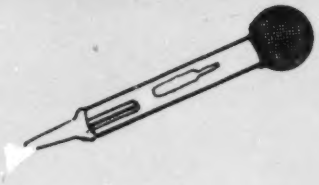
upright stand
1 piece - ¼" steel 2' x 3' or 1 piece - ¾" plywood 2' x 3' (2 ft. x 3 ft. = .6 x .9 m)
floor stand
4 corner irons

See simulator plans

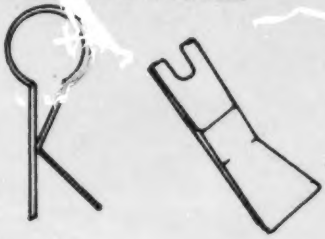
Also see storage box plans

TOOLS/EQUIPMENT/SUPPLIES

RADIATOR CAP TESTER



HYDROMETER

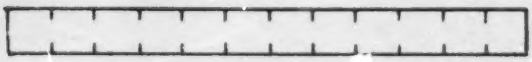


HOSE CLAMP TOOL

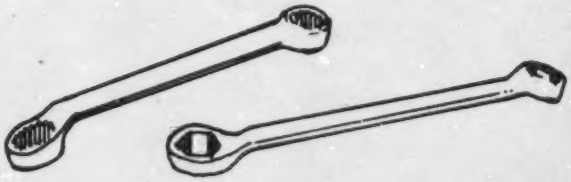
PYREX BEAKER

THERMOMETER

SPRING SCALES

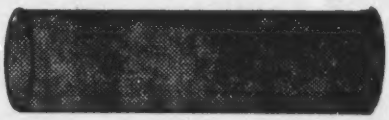


12" RULER

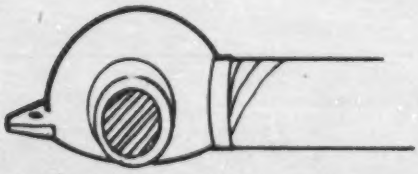


BOX END WRENCHES

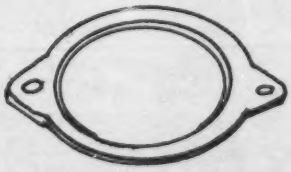
RADIATOR CAP



HOSE



THERMOSTAT



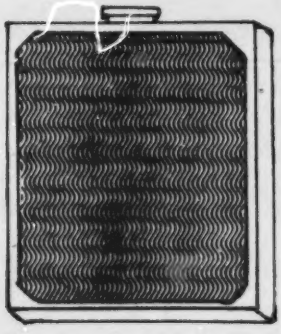
GASKET (WATER PUMP)

GASKET SEALER

ANTIFREEZE

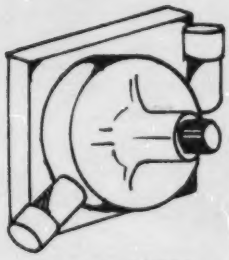
HOSE CLAMPS

FAN BELT

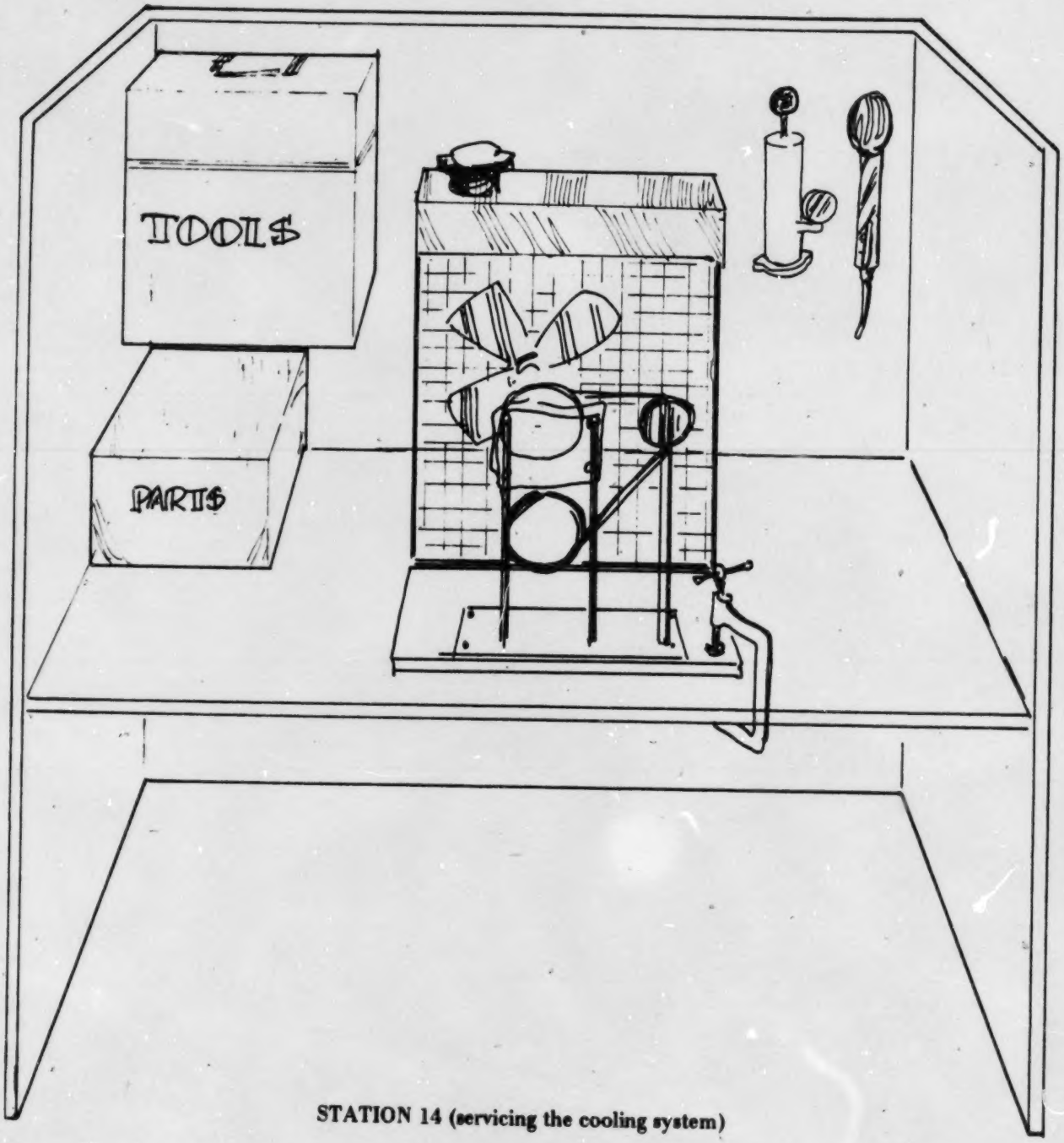


RADIATOR

GENERATOR PULLEY



WATER PUMP



STATION 14 (servicing the cooling system)

TRACTOR MECHANICS LEARNING STATION NO. 15

LEARNING ACTIVITY PACKAGE NO. 55

Servicing a Dry Clutch

Description of Use

This kit can be used to enable the student to:

1. check spring tension on pressure plate springs
2. check clutch plate for warpage
3. check flywheel friction surface for roughness
4. replace pressure plate
5. use line bar to align clutch disk

Tools Needed

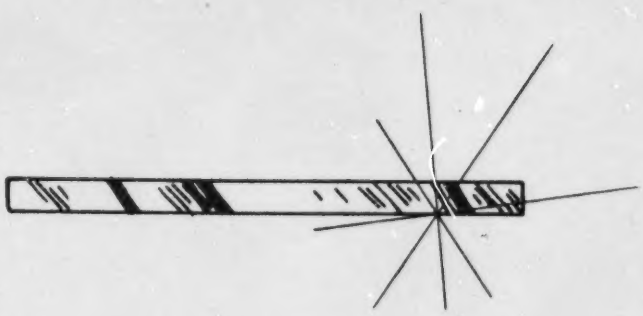
1. set of open-end wrenches
2. steel straight edge
3. line bar
4. large screwdriver

Source of Materials Used in Developing Station

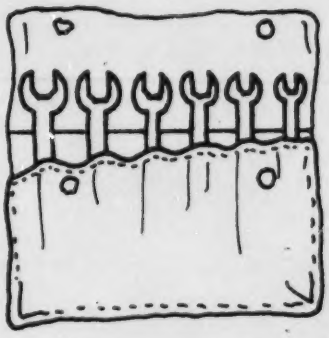
Secure from slavage yard, tractor, truck, auto dealership, or repair shop the following materials:

1. single clutch assembly
2. flywheel to mount clutch
3. clutch disk - rigid
4. pressure plate assembly
5. transmission housing with spline and throw-out bearing (with or without transmission, but preferably without transmission)
6. clutch line bar

TOOLS/EQUIPMENT/SUPPLIES

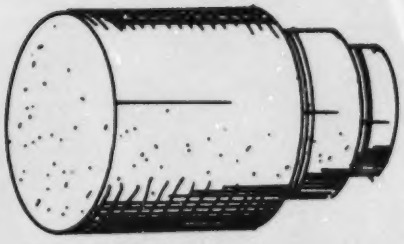


STEEL STRAIGHT EDGE

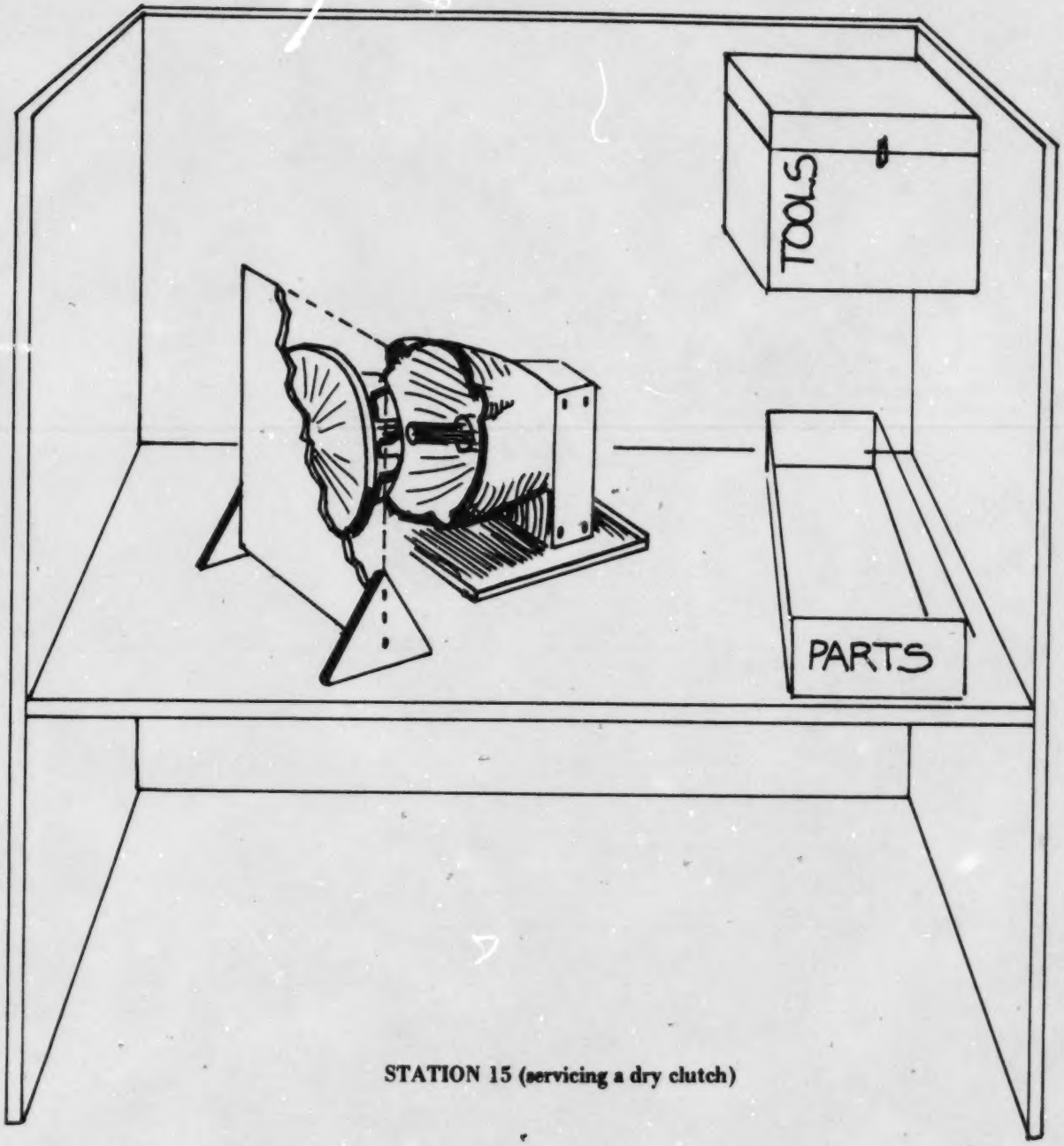


OPEN-END WRENCHES

LARGE SCREWDRIVER



LINE BAR



STATION 15 (servicing a dry clutch)

TRACTOR MECHANICS LEARNING STATION NO. 16

LEARNING ACTIVITY PACKAGE NOS. 67, 68, and 69

Removing the Axle and Replacing Seals and Gaskets

Description of Use

This kit can be used to enable the student to:

1. replace the rear axle
2. replace the axle bearing
3. replace the outer seal
4. replace the inner seal
5. replace gaskets
6. adjust end play
7. preload axle bearings

Special Instructions to the Teacher

If a skid unit is available it may be used. However, if these units are being used for other tasks, it may be best to construct a simulator.

You may wish to reserve the use of the skid units or other operable equipment for tasks which require live equipment.

Tools Needed

1. special tool for checking bearing preload
2. special adapter for torque wrench
3. spring scales
4. axle puller
5. set of socket wrenches
6. dial indicator
7. screwdriver (12")
8. stands (2)
9. seal puller
10. seal driver

Supplies Needed

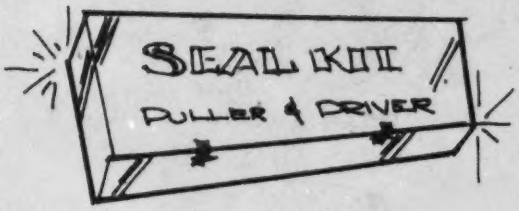
1. inner seals (2)
2. outer seals (2)
3. gaskets (10)
4. transmission grease
5. replacement liners for seals (2)
6. shims (10)
7. axle
8. bearing
9. collar

Simulator Materials

1. rear end housing with axles
2. stands for mounting housing

Sources of Materials for Simulator

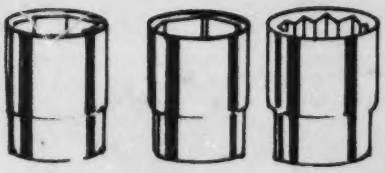
Rear end housing may be secured free or at a moderate cost from local tractor dealers or from local salvage yards. Sometimes, a local farmer may donate such equipment.



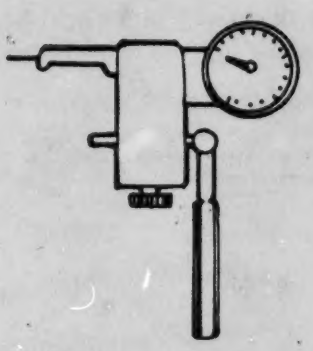
ADAPTER FOR TORQUE WRENCH

SPRING SCALES

AXLE PULLER

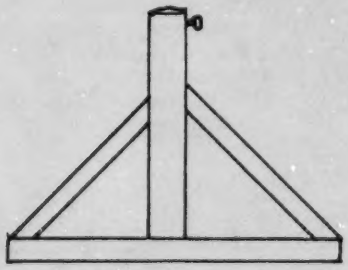


SET OF SOCKET WRENCHES



DIAL INDICATOR

SCREWDRIVER



UPRIGHT STAND

57

INNER SEALS

OUTER SEALS

GASKETS

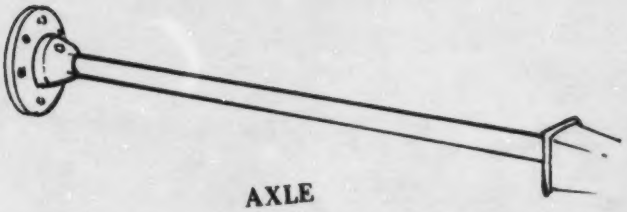
TRANSMISSION GREASE

REPLACEMENT LINERS FOR SEALS

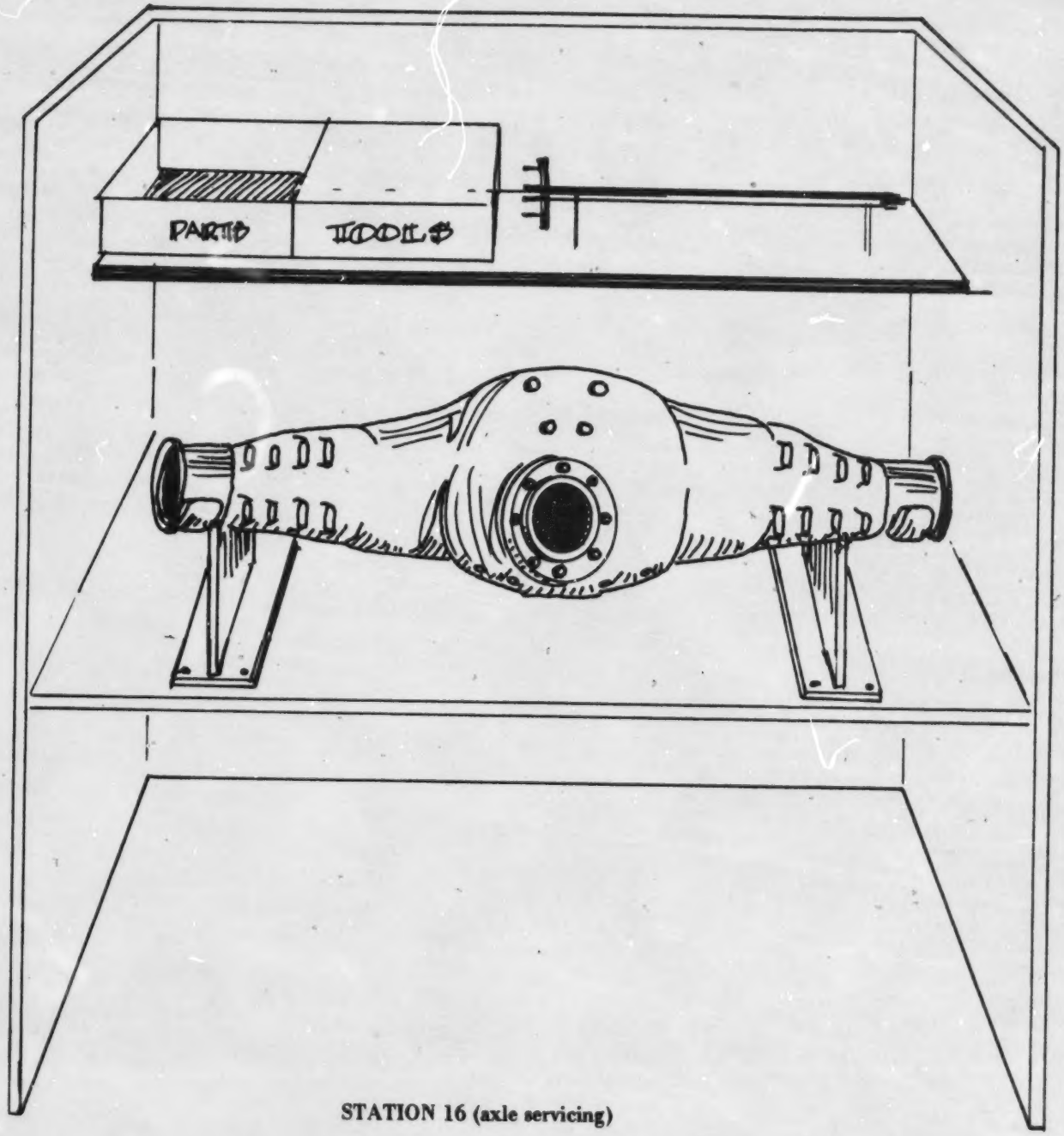
REAR END HOUSING

BEARING

COLLAR



AXLE



STATION 16 (axle servicing)

58

TRACTOR MECHANICS LEARNING STATION NO. 17

LEARNING ACTIVITY PACKAGE NO. 74

Packing Wheel Bearings

Description of Use

This kit can be used to enable the student to:

1. remove a wheel drum (brake drum)
2. identify worn wheel bearings
3. replace wheel bearings
4. pack wheel bearings
5. replace front wheel grease seal
6. torque wheel bearings
7. remove wheel (rim)
8. identify worn rim

Special Instructions to the Teacher

If a skid unit is available, it may be used. However, if these units are being used for other tasks, it may be best to construct a simulator.

Tools Needed

1. torque wrench
2. pliers
3. hammer (machinist)
4. small paint brush
5. drift punch (brass) (or short broom stick)
6. lug wrench

Supplies Needed

1. set of new bearings
2. set of worn bearings
3. new seal
4. damaged seal
5. multi-purpose grease
6. kerosene or diesel fuel
7. cleaning cloth
8. extra cotter pins
9. extra gaskets
10. wheel (rim)

Simulator Materials

1. a complete front wheel assembly including:

    a. spindle
    b. oil seal
    c. oil seal cup
    d. inner bearing cone and roller
    e. inner bearing cup
    f. nut
    g. outer bearing cup
    h. outer bearing cone and roller
    i. washer
    j. cotter pin
    k. gasket
    l. hub cap

2. ¼" x 2" x 2' flat iron

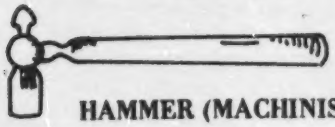
3. wheel (rim)

Sources of Materials for Simulator

1. local tractor dealers
2. local salvage yards
3. local farmers

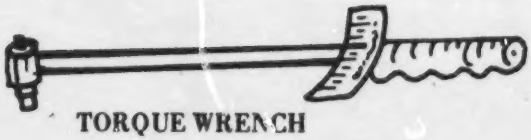
TOOLS/EQUIPMENT/SUPPLIES

DAMAGED SEAL

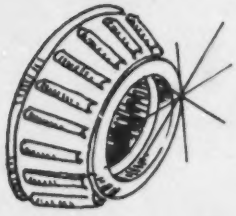


HAMMER (MACHINIST)

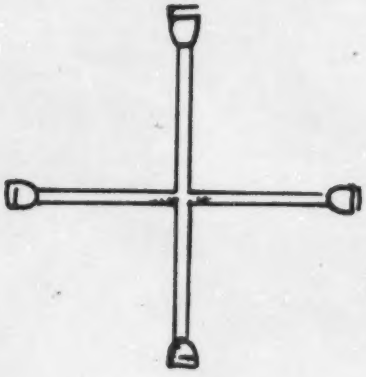
EXTRA GASKET



TORQUE WRENCH



NEW BEARINGS



LUG WRENCH

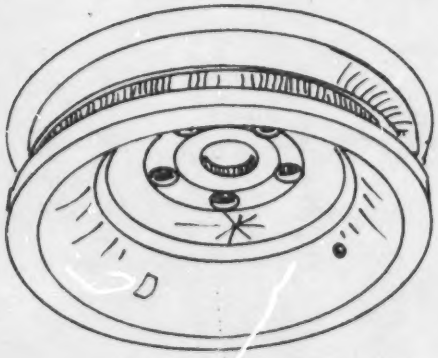
GREASE

WORN BEARINGS

CLEANING CLOTH

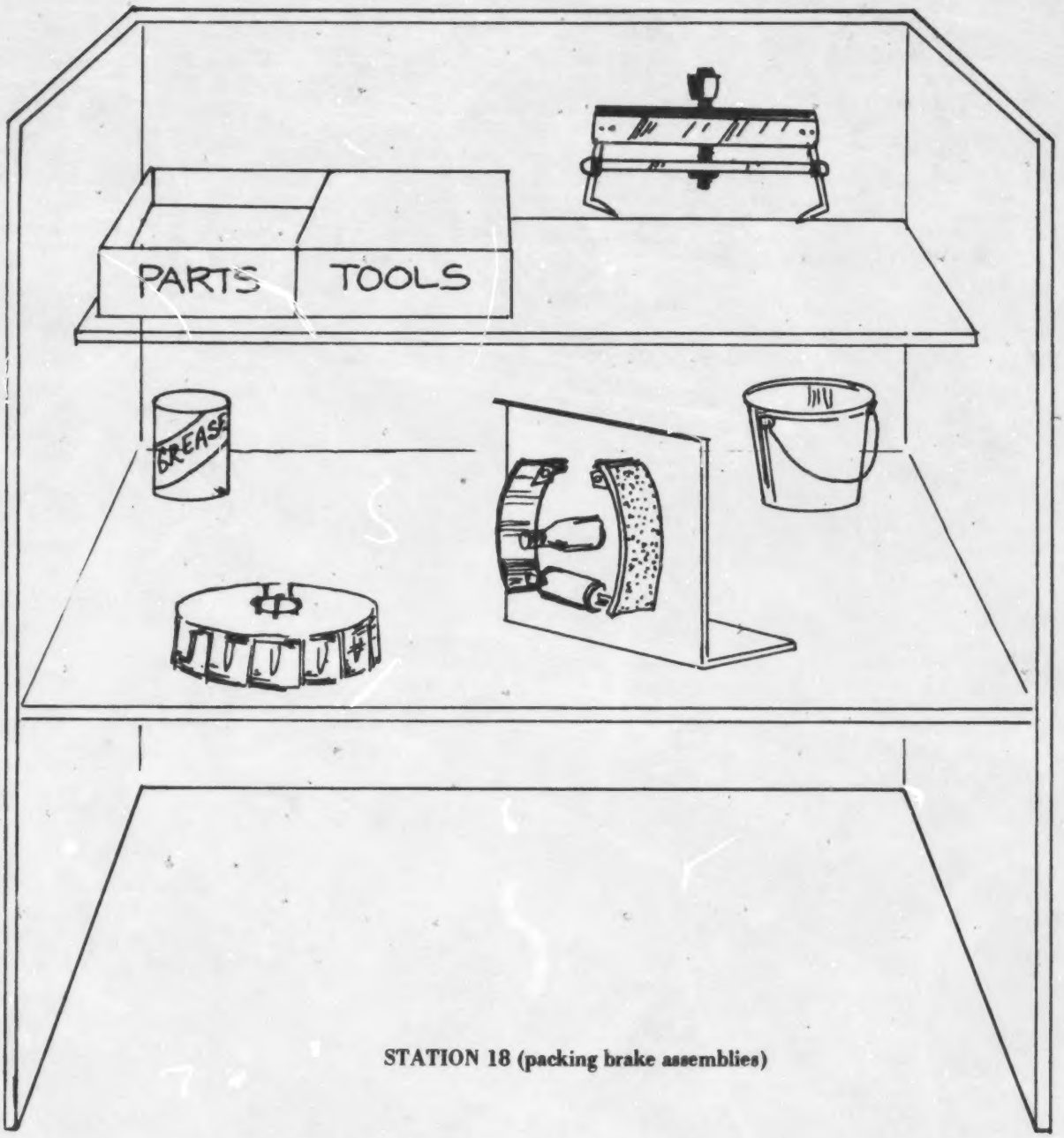
DRIFT PUNCH (BRASS)

DIESEL FUEL



WHEEL (RIM)

62



STATION 18 (packing brake assemblies)

63

TRACTOR MECHANICS LEARNING STATION NO. 18

LEARNING ACTIVITY PACKAGE NO. 77

Repairing Brake Assemblies

Description of Use

This kit can be used to enable the student to:

1. replace brake drum
2. replace brake shoes
3. replace brake cylinder
4. hone brake cylinder
5. install brake cylinder kit

Special Instructions to the Teacher

If a skid unit is available, it may be used for this purpose. However, if these are being used for other tasks, it may be best to construct a a simulator. You may wish to reserve the skid unit for tasks which require live equipment.

Tools Needed

1. drum puller
2. open end wrench, 1½"
3. brake adjusting tool
4. brake spring pliers
5. needle nose pliers
6. screwdriver, 12"
7. set of ignition wrenches
8. putty knife

Supplies Needed

1. brake fluid
2. emery cloth
3. cleaning cloth

Simulator Materials Needed

1. ¼" x 1" metal (4 ft.)
2. rear axle housing with axle
3. rear brake drum including brake
4. ½" x 12" x 12" metal plate
5. ¾" x 2' x 2' plyboard (optional)

Sources of Materials for Simulator

1. farm equipment dealers
2. salvage yards
3. automobile dealers or repair shops

TOOLS/EQUIPMENT/SUPPLIES

OPEN-END WRENCH

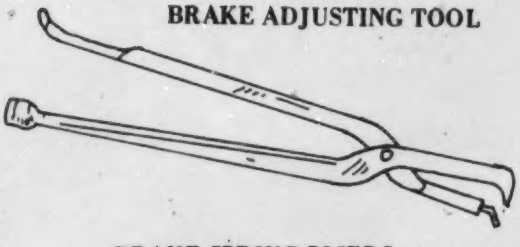
SCREWDRIVER

PUTTY KNIFE

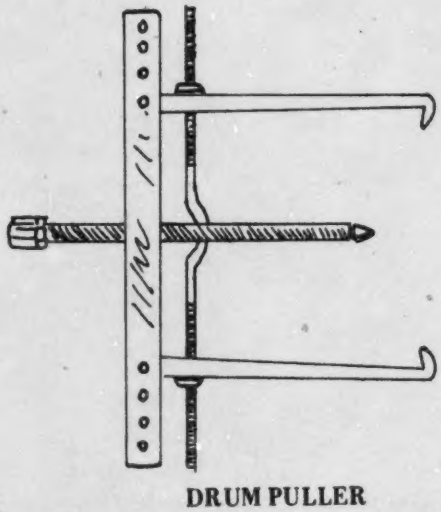
SET OF IGNITION WRENCHES

NEEDLE NOSE PLIERS

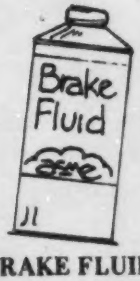
BRAKE ADJUSTING TOOL



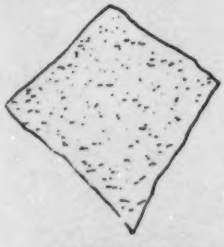
BRAKE SPRING PLIERS



DRUM PULLER

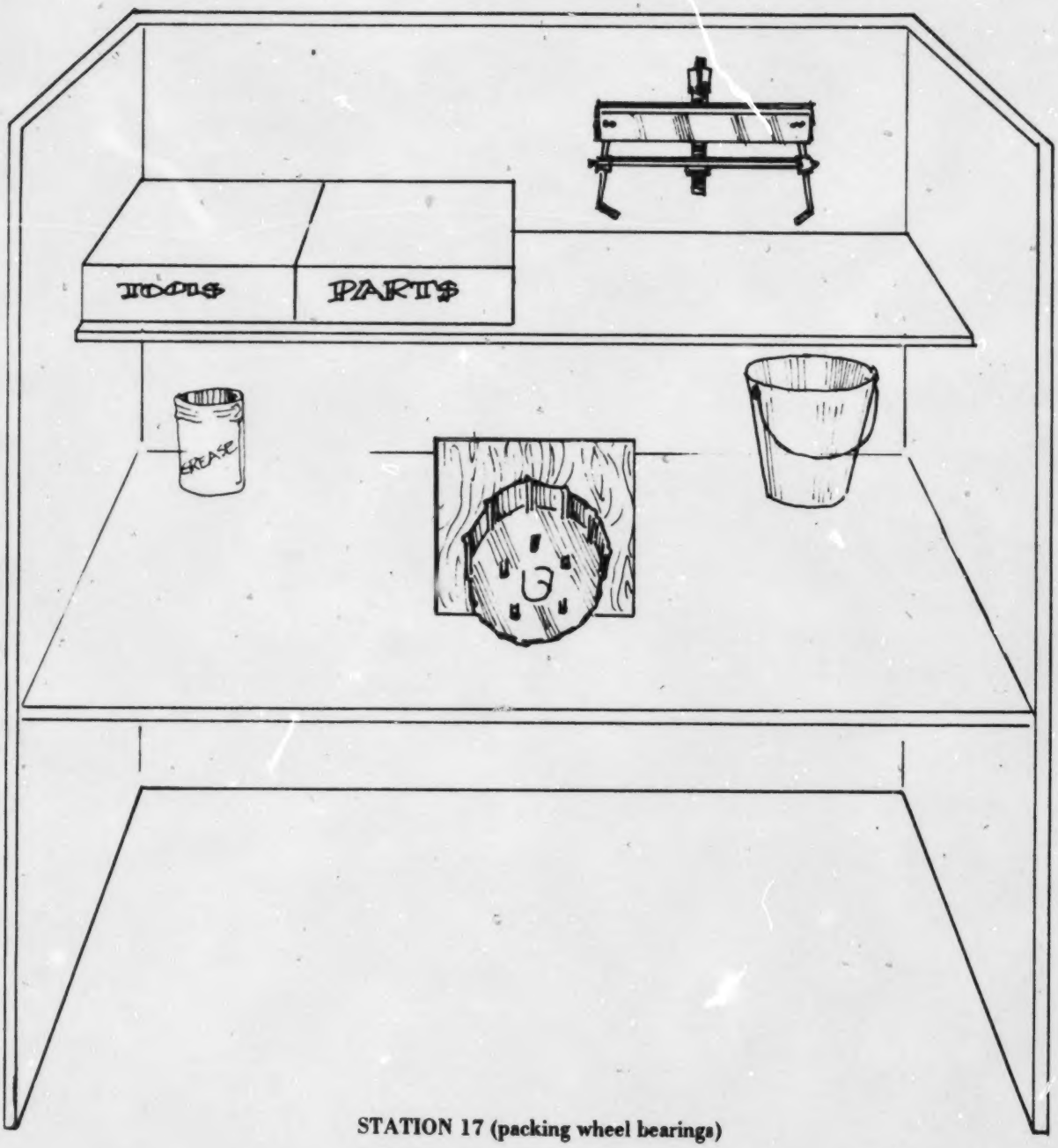


BRAKE FLUID



EMERY CLOTH

CLEANING CLOTH



STATION 17 (packing wheel bearings)

TRACTOR MECHANICS LEARNING STATION NO. 19

LEARNING ACTIVITY PACKAGE NO. 78

Servicing the Valve Assembly

Description of Use

This kit can be used to enable the student to:

1. remove camshaft bearings
2. replace camshaft bearings
3. measure camshaft wear

Special Instructions to the Teacher

Since camshaft bearings are hard to get in and out, this simulator would give the student experience on an item less expensive than a live project. The camshaft parts may be cut out with an arc welder and mounted, or obtain a small block engine and use the entire block for this purpose.

Tools Needed

camshaft bearing pullers and drivers

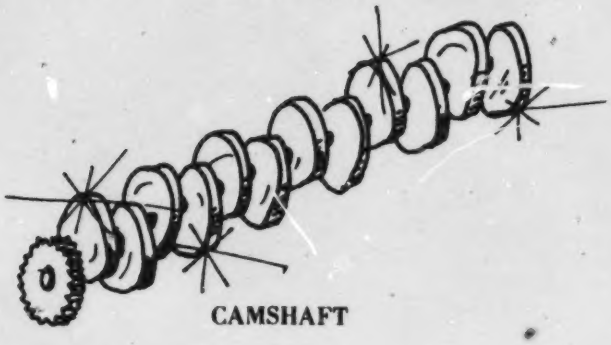
Simulator Materials

1. old engine block stripped except camshaft, OR
2. bearing parts from engine block to be mounted as diagramed
3. 3 pieces, 1/4" x 6" x 6" plate steel
4. 1 piece, 1/4" x 6" x 24" plate steel
5. camshaft

Source of Simulator Materials

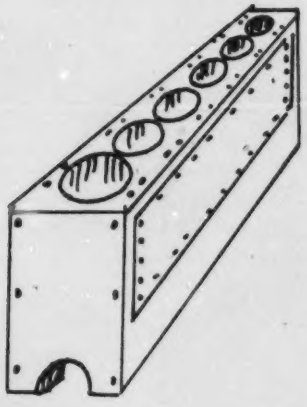
1. salvage yard
2. tractor dealership
3. automobile dealership

TOOLS/EQUIPMENT/SUPPLIES

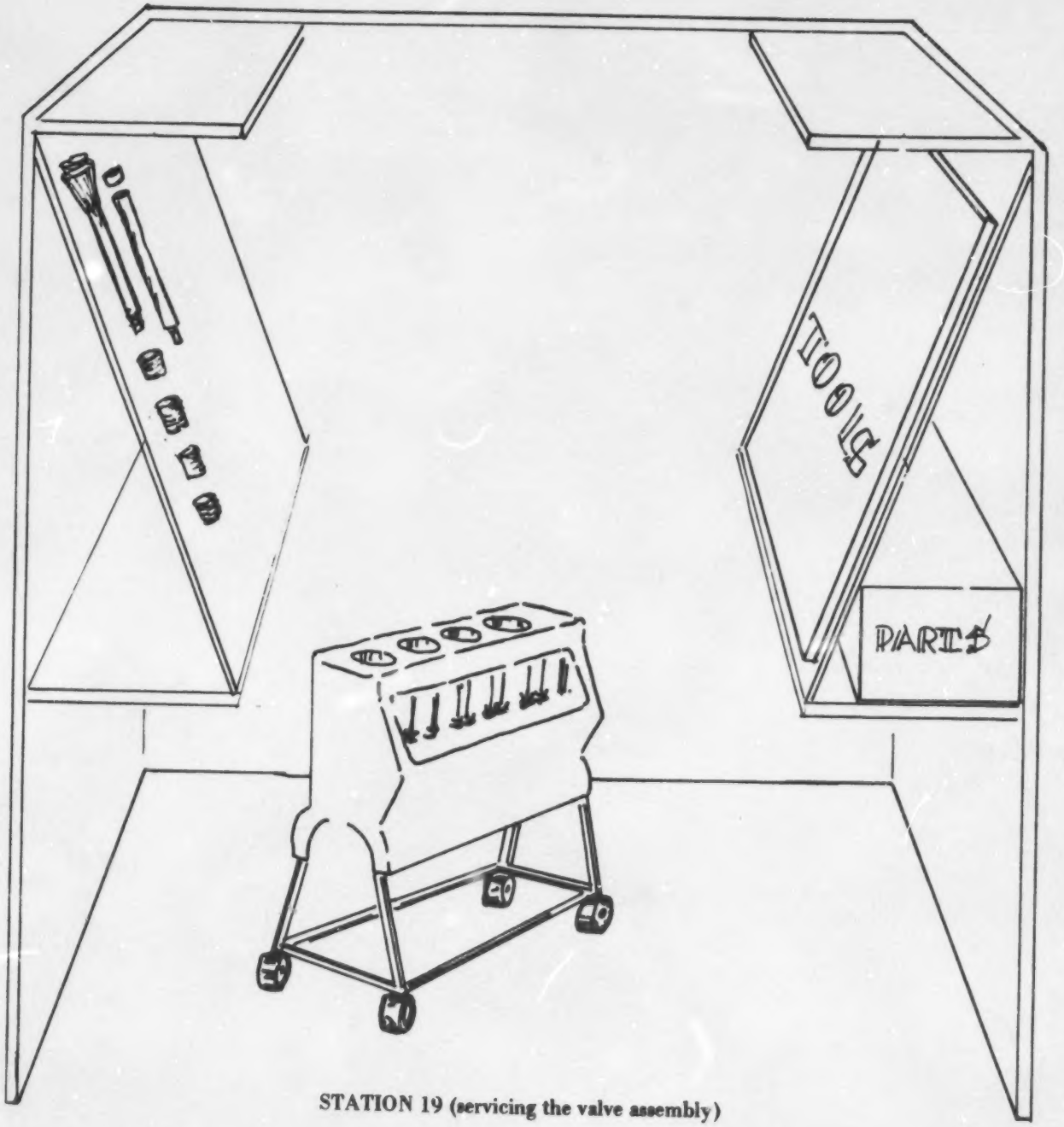


CAMSHAFT

CAMSHAFT BEARING PULLERS AND DRIVERS



OLD ENGINE BLOCK



STATION 19 (servicing the valve assembly)

TRACTOR MECHANICS LEARNING STATION NO. 20

LEARNING ACTIVITY PACKAGES NOS. 79 and 80

NO. 79 Replacing Rocker Arms
NO. 80 Adjusting Valves

Description of Use

This kit can be used to enable the student to:

1. adjust valve clearance
2. measure valve-stem guide clearance
3. replace rocker arms
4. test valve springs

Special Instructions to the Teacher

This unit can be used in place of a live unit, run at a slower speed for adjusting valves.

Tools Needed

1. flat thickness feeler gauge
2. 9/16 and 1/2 combination wrench
3. flat point or regular screwdriver
4. 0 to 1 micrometer (outside micrometer)
5. telescoping gauges
6. valve spring compressor
7. valve spring tester

Supplies Needed

1. cleaning cloth
2. oil cup

Software Needed:

1. I & T shop manual
2. operator's manual

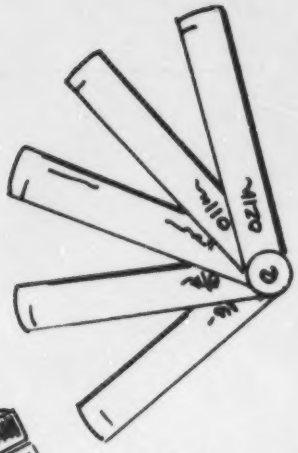
Simulator Materials Needed

1. 1 4-cylinder engine head with valve assembly (head should be cracked or damaged)
2. camshaft for same
3. 2 flange or pillow block bearings to fit camshaft
4. V pulley that could be fitted to camshaft
5. 1/3 HP electric motor with pulley
6. 1/4" or 3/16" plate steel for mounting head assembly and camshaft

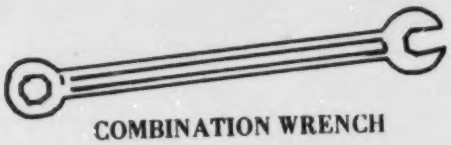
Source of Materials

1. farm equipment dealer
2. salvage yard
3. car or truck dealer repair shop

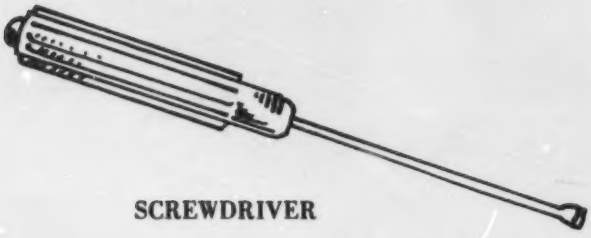
TOOLS/EQUIPMENT/SUPPLIES



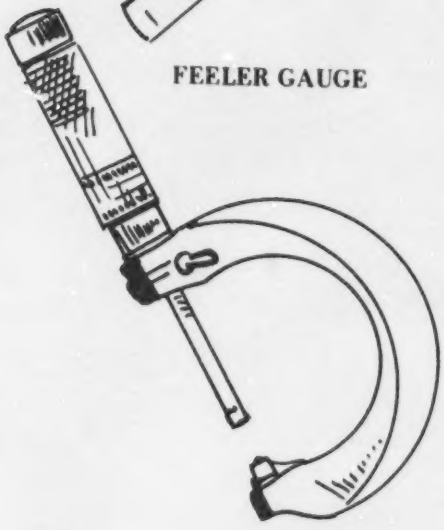
FEELER GAUGE



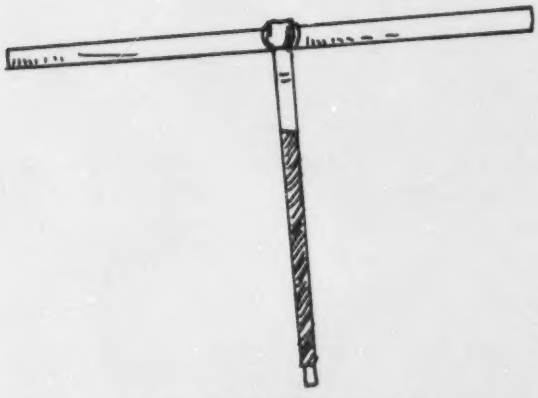
COMBINATION WRENCH



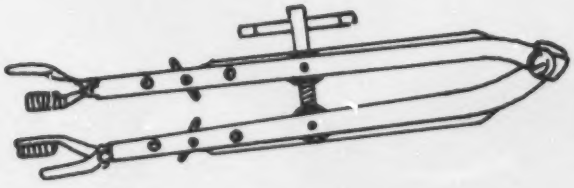
SCREWDRIVER



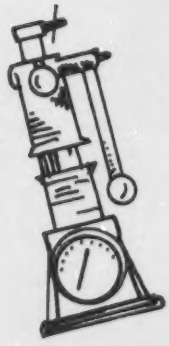
MICROMETER



TELESCOPING GAUGE

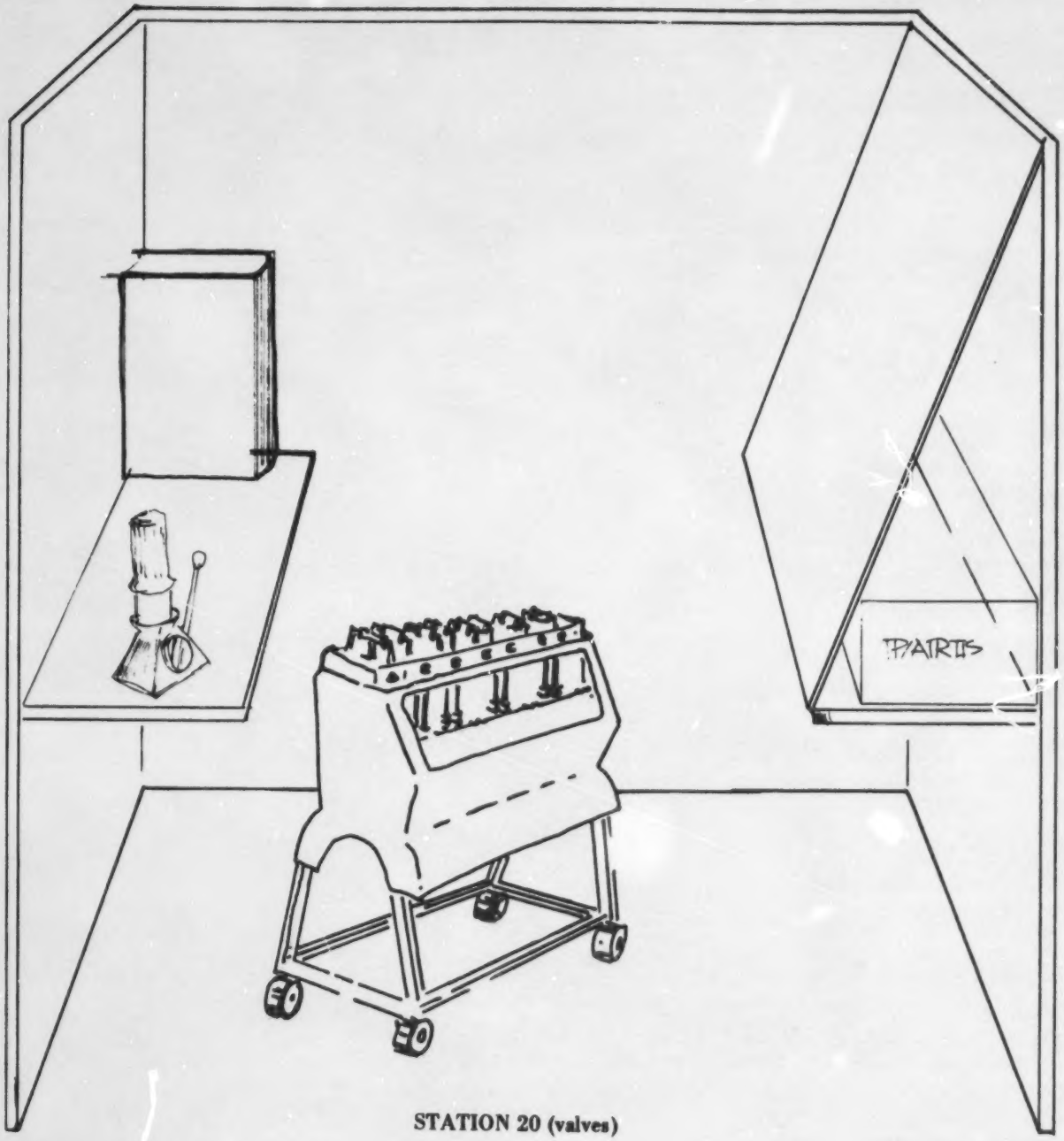


VALVE SPRING COMPRESSOR



VALVE SPRING TESTER

CLEANING CLOTH



STATION 20 (valves)

TRACTOR MECHANICS LEARNING STATION NO. 21

LEARNING ACTIVITY PACKAGE NO. 82

Servicing the Piston Assembly

Description of Use

This kit can be used to enable the student to:

1. measure cylinder taper
2. measure piston-ring end gap

Special Instructions to the Teacher

This unit can be used to develop skills in measuring tolerance or limit in the cylinder and piston assembly.

Tools Needed

1. flat thickness feeler gauge
2. cylinder bore gauge (optional)
3. inside caliper (optional)

Supplies Needed

rings to fit sleeve chosen (extras are needed)

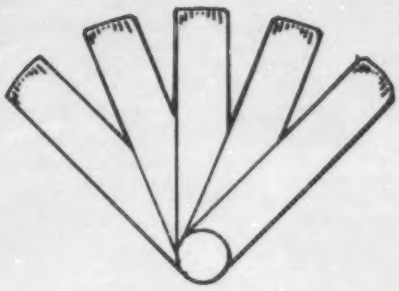
Simulator Materials

1. sleeve
2. 1/2" x 12" x 12" plate steel
3. rings for designated cylinder
4. angle iron for legs, 1" x 1"

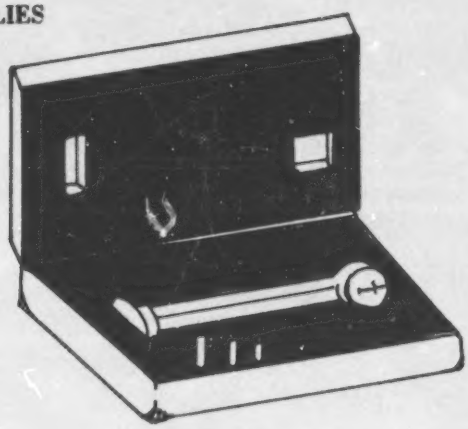
Source of Materials

tractor dealer

TOOLS/EQUIPMENT/SUPPLIES

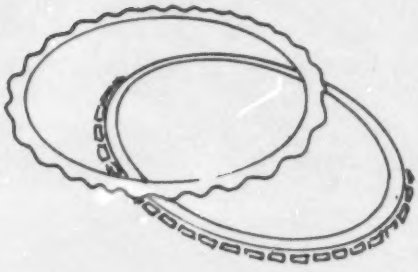


FEELER GAUGE

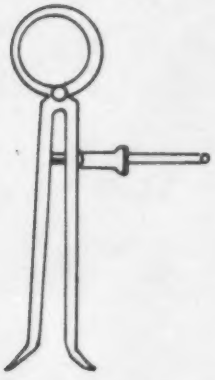


CYLINDER BORE GAUGE

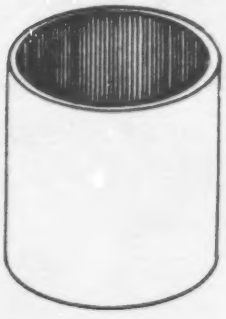
RING GROOVE CLEANER



RINGS



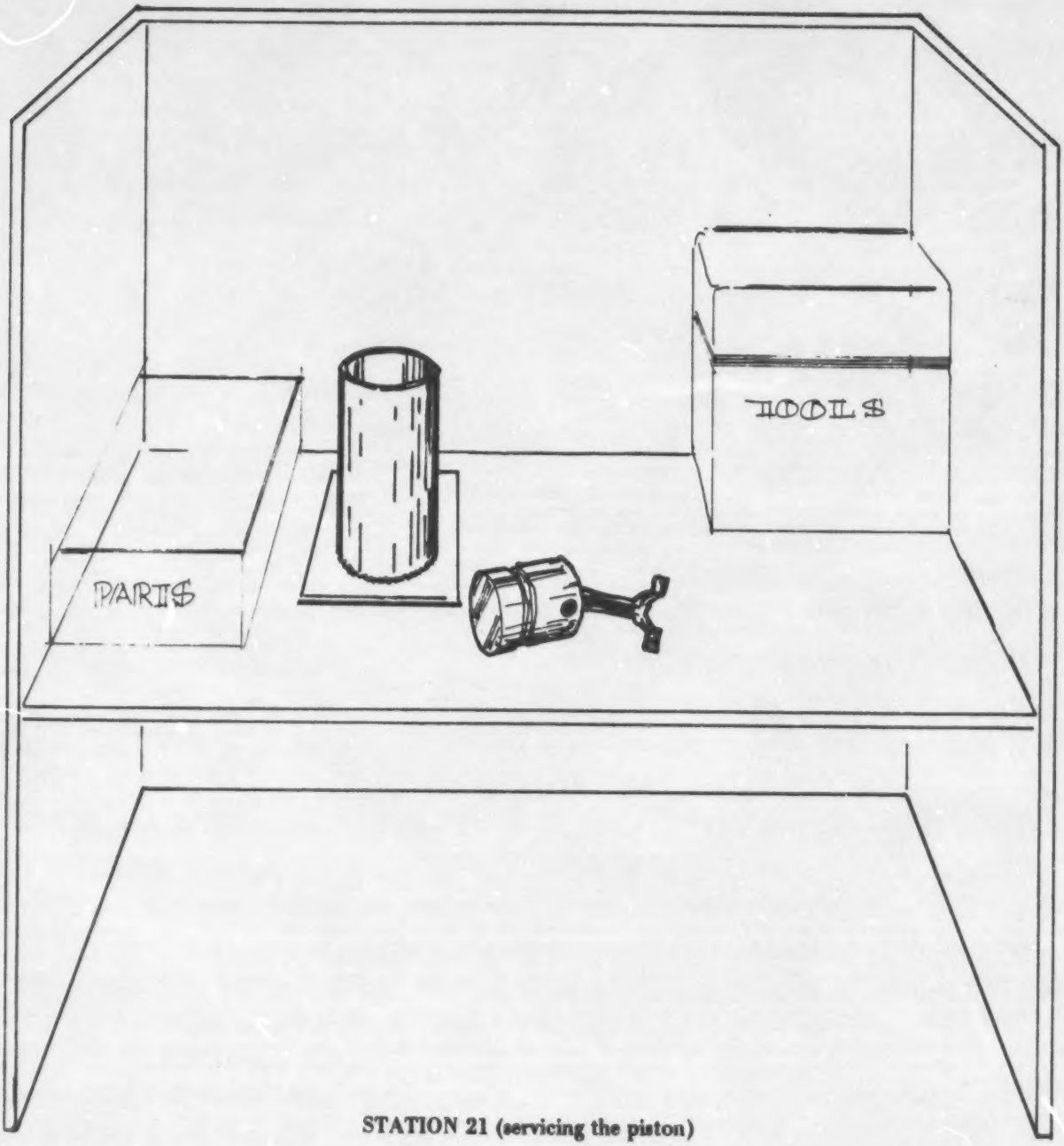
INSIDE CALIPER



CYLINDER

PLATE STEEL

ANGLE IRON



STATION 21 (servicing the piston)

TRACTOR MECHANICS LEARNING STATION NO. 22

LEARNING ACTIVITY PACKAGE NO. 82

Servicing the Piston Assembly

Description of Use

1. measure piston-ring land clearance
2. remove carbon from ring groove (practice using ring groove cleaner)
3. replace piston rings
4. measure piston

Special Instructions to the Teacher

Obtain sufficient pistons with carbon in them if possible; if not, let student practice selecting right width for piston ring groove cleaner.

Tools Needed

1. outside micrometer
2. flat thickness feeler gauge
3. ring expander
4. ring groove cleaner

Supplies Needed

cleaning cloth

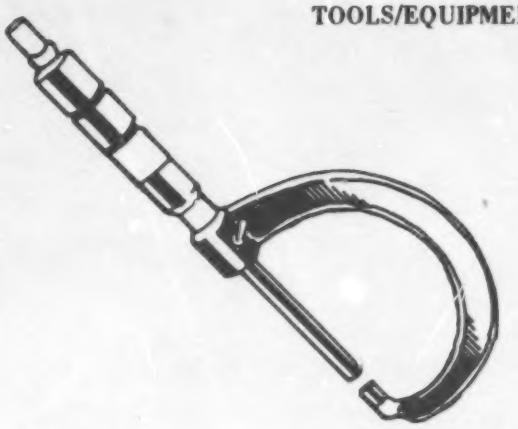
Simulator Materials

1. pistons
2. rings to mate pistons

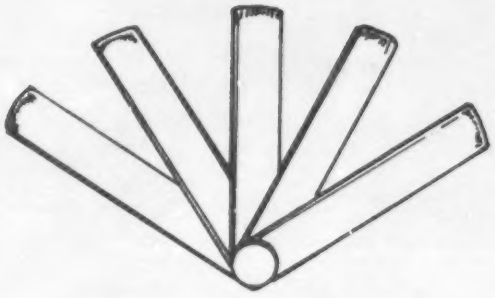
Source of Materials for Simulators

1. farm equipment dealers
2. salvage yards
3. automotive dealers or repair shops

TOOLS/EQUIPMENT/SUPPLIES

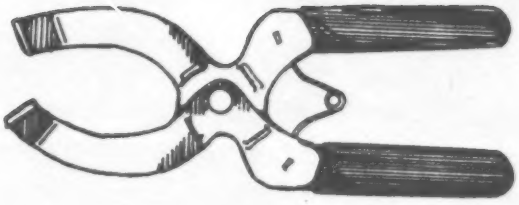


OUTSIDE MICROMETER

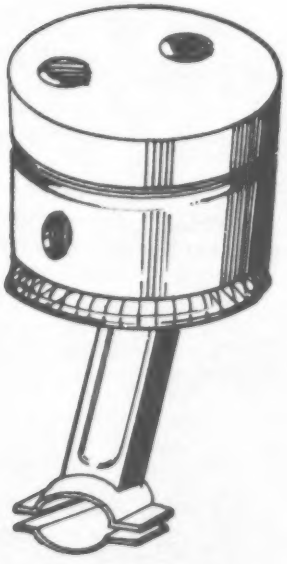


FEELER GAUGE

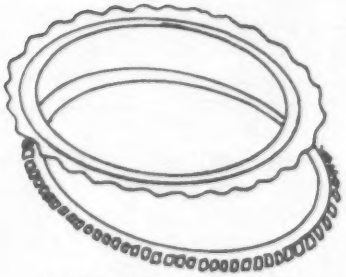
RING GROOVE CLEANER



RING EXPANDER

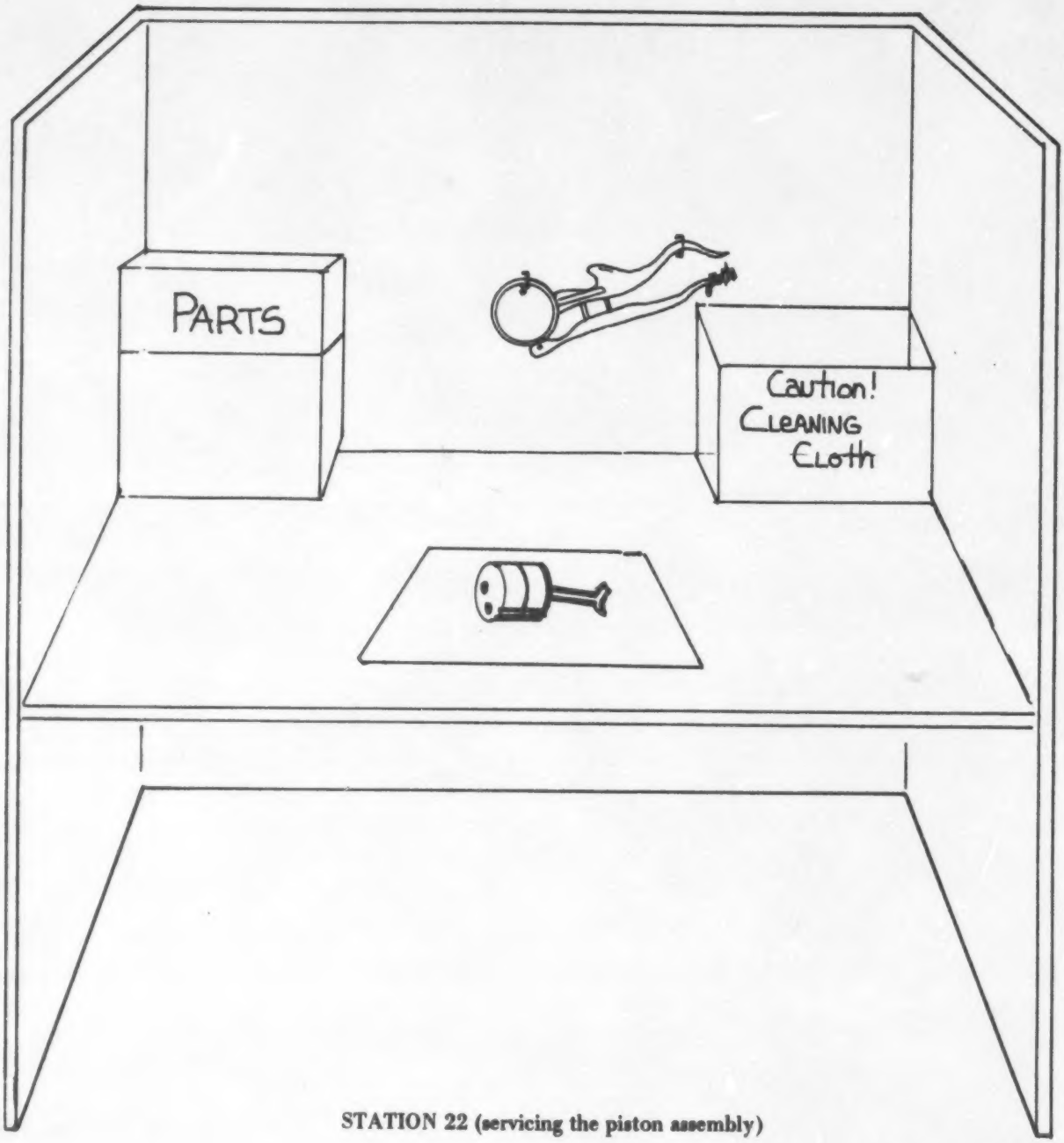


PISTONS



RINGS TO MATE PISTONS

CLEANING CLOTH



STATION 22 (servicing the piston assembly)

TRACTOR MECHANICS LEARNING STATION NO. 23

LEARNING ACTIVITY PACKAGE NO. 83

Servicing the Piston Cylinder

Description of Use

This kit can be used to enable the student to:

1. de-glaze cylinder
2. remove cylinder ridge

Special Instructions to the Teacher

Even after cylinder has been de-glazed the principles and use of cylinder hone can be used with this unit. A new ring can be replaced each time to give student experience in removing cylinder ridge.

Tools Needed

1. cylinder ridge reamer
2. cylinder hone (deglazer)
3. variable speed electric drill

Supplies Needed

1. light oil and oil cup
2. cleaning cloth

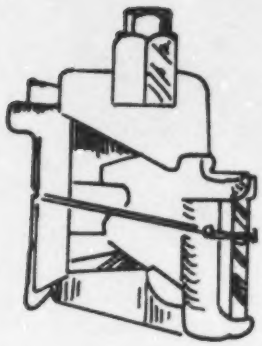
Simulator Materials

1. cylinder sleeves or cylinders

Source of Materials for Simulator

1. farm equipment dealer
2. salvage yard

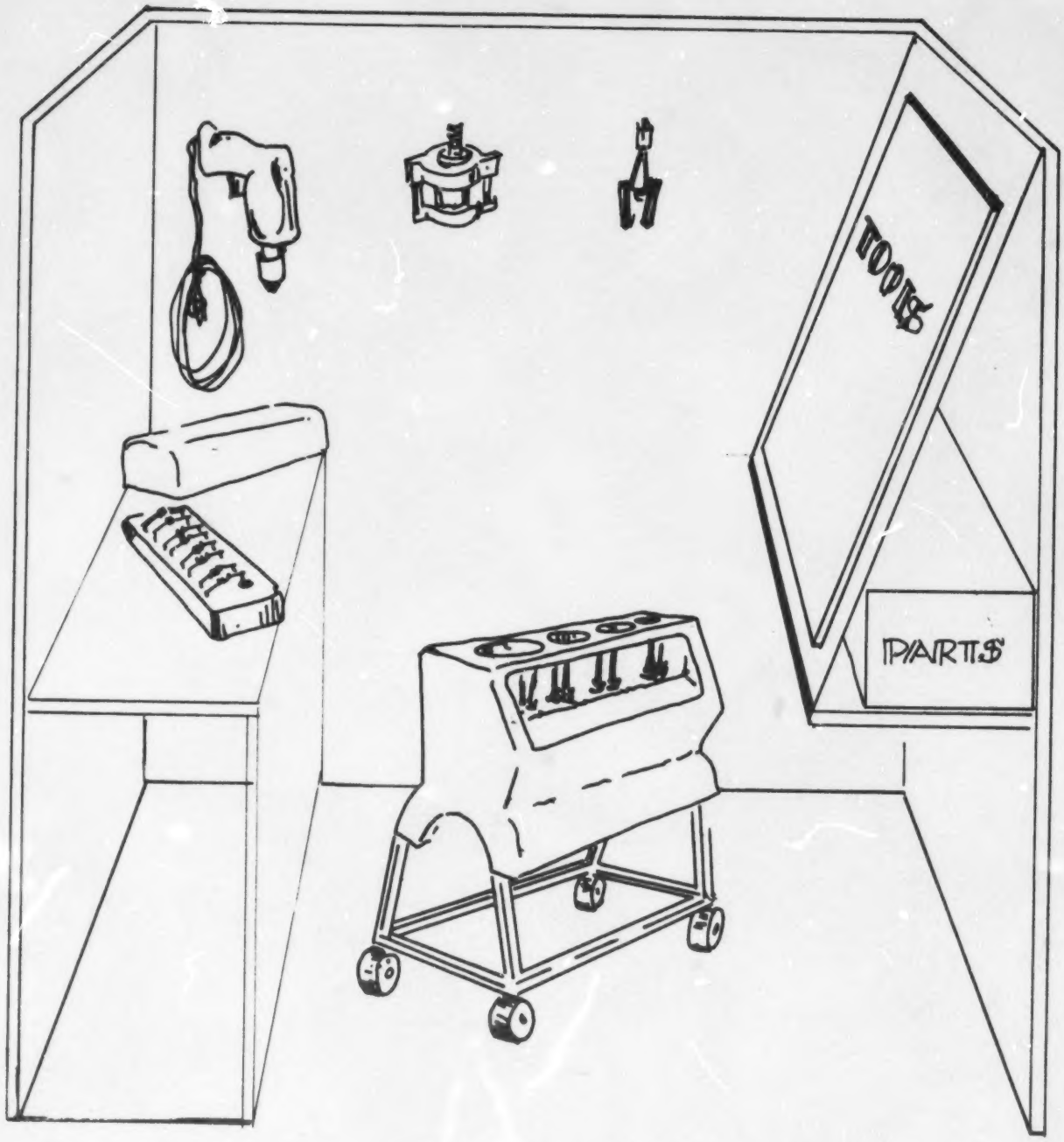
TOOLS/EQUIPMENT/SUPPLIES



CYLINDER RIDGE REAMER

SLEEVE

DRILL



STATION 23 (servicing the piston, cylinder)

TRACTOR MECHANICS LEARNING STATION NO. 24

LEARNING ACTIVITY PACKAGES

NO. 84 Installing Connecting Rods
NO. 85 Installing a Crankshaft

Description of Use

This kit can be used to enable the student to:

1. install connecting rod caps
2. install crankshaft
3. install main bearing caps
4. torque main bearings

Special Instructions to the Teacher

Even though this is not a complete engine the principles of crankshaft installation can be learned.

Tools Needed

1. micrometer
2. soft face hammer
3. torque wrench
4. necessary wrenches to fit connecting rod and main bearing caps

Supplies Needed

1. plastigage
2. oil cup
3. cleaning rag
4. main bearings (need not be renewed each time)
5. rod bearings (need not be renewed each time)

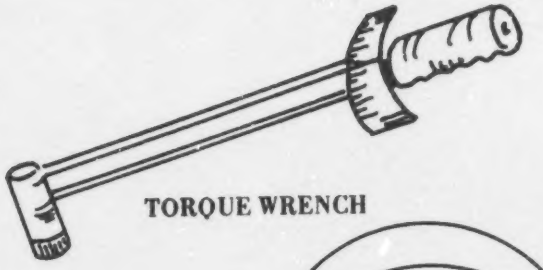
Simulator Materials

1. 4 cylinder crankshaft
2. 4 main bearing caps
3. 1 connecting rod and cap

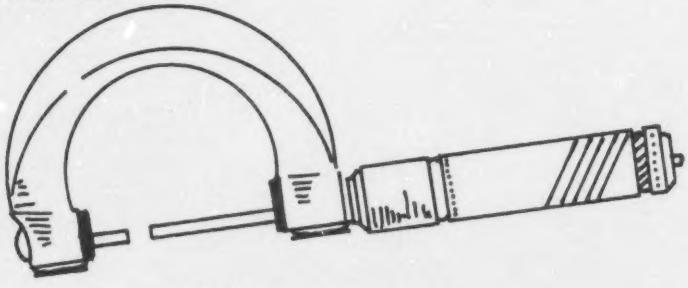
Source of Materials

1. salvage yard
2. farm equipment dealer
3. automotive dealer

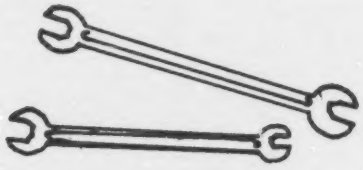
TOOLS/EQUIPMENT/SUPPLIES



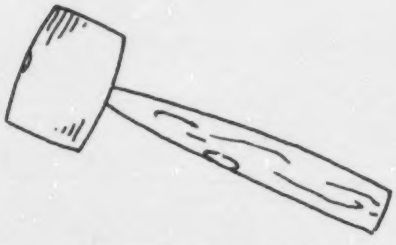
TORQUE WRENCH



MICROMETER



WRENCHES

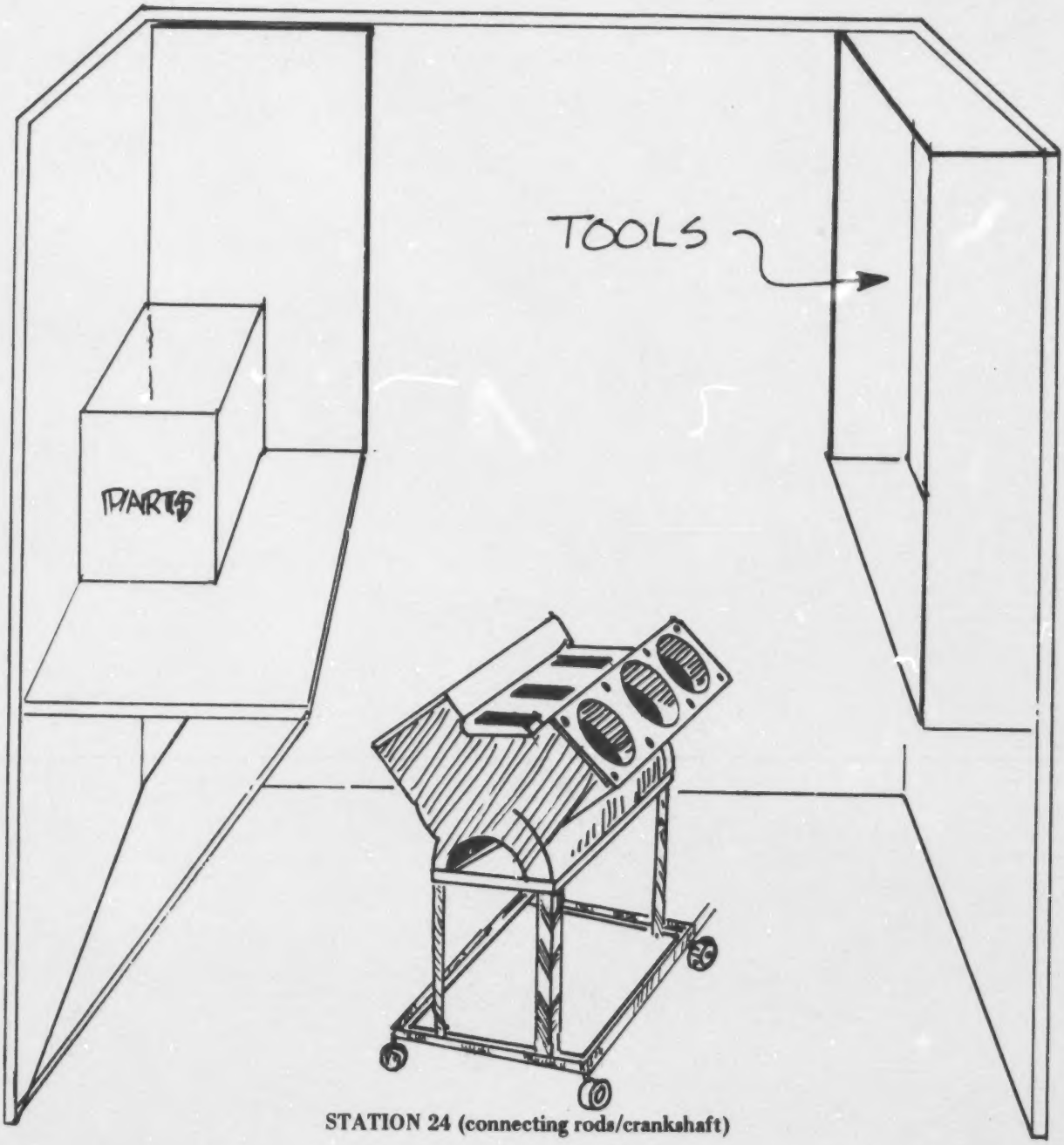


SOFT FACE HAMMER

CLEANING RAG

MAIN BEARING

ROD BEARING



STATION 24 (connecting rods/crankshaft)

84

TRACTOR MECHANICS LEARNING STATION NO. 25

LEARNING ACTIVITY PACKAGE NO. 86

Servicing the Crankshaft

Description of Use

This kit can be used to enable student to:

1. measure crankshaft to determine wear or taper - make a judgmental decision of whether to discard, regrind, or use as is.

Special Instructions to the Teacher

Choose a crankshaft that has some good bearing journals and bad ones so that decision has to be made with the micrometer.

Tools Needed

1. outside micrometer
2. cleaning cloth

Supplies Needed

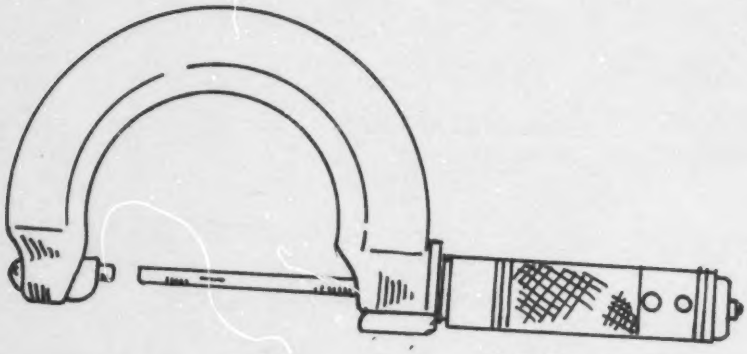
None

Simulator Materials

1. crankshaft, preferably a 3 or 4 cylinder
2. plywood box for storage

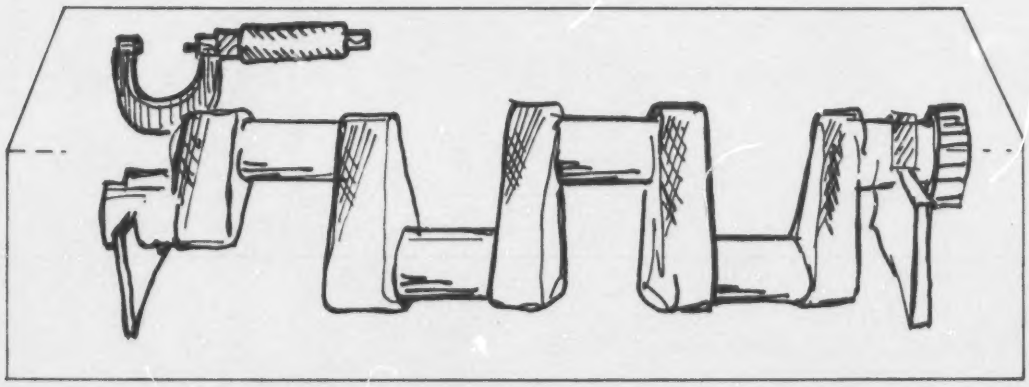
Source for Simulator

1. salvage yard
2. tractor dealer
3. automobile dealer



OUTSIDE MICROMETER

CRANKSHAFT



STATION 25 (servicing the crankshaft)

87

TRACTOR MECHANICS LEARNING STATION NO. 26

LEARNING ACTIVITY PACKAGE NO. 86

Servicing the Crankshaft

Description of Use

This kit can be used to enable the student to do the following:

1. change the engine oil seal

Special Instruction to the Teacher

Student can practice removing and installing oil seal with this unit.

Tools Needed

1. seal puller
2. soft face hammer

Supplies Needed

1. oil seals to fit cover chosen
2. cleaning cloth

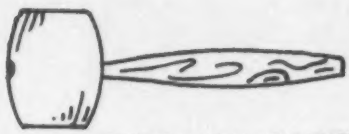
Simulator Materials

1. front engine cover
2. plate steel to mount cover on and for base
3. flat iron to brace it

Source of Simulator Materials

1. tractor dealership
2. salvage yard

TOOLS/EQUIPMENT/SUPPLIES

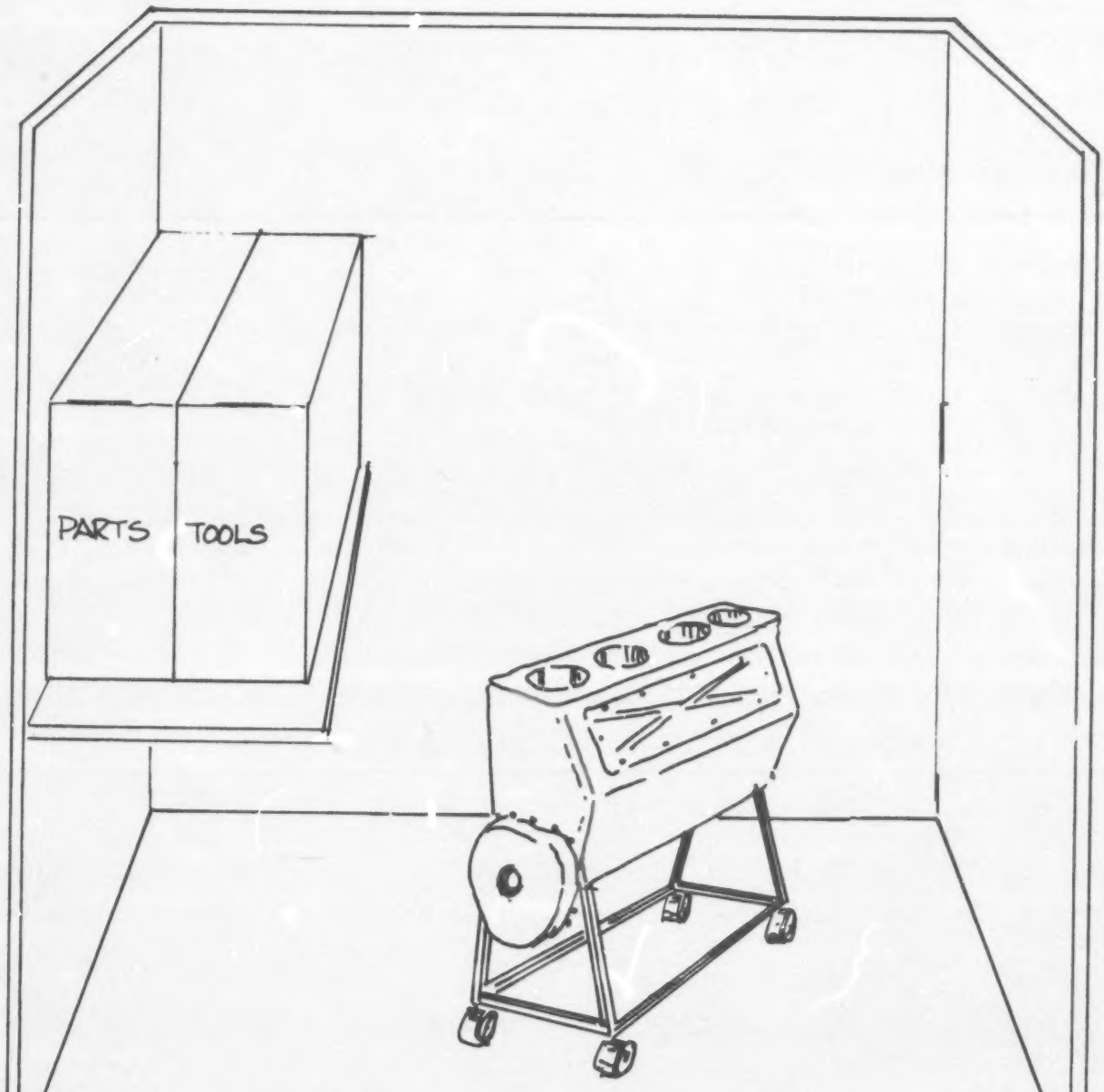


SOFT FACE HAMMER

SEAL PULLER

OIL SEAL

CLEANING CLOTH



STATION 26 (oil seal)

TRACTOR MECHANICS LEARNING STATION NO. 27

LEARNING ACTIVITY PACKAGE NO. 88

Installing the Timing Gear or Chain

Description of Use

This kit can be used to enable the student to:

1. replace timing gear so that all marks coincide with correct timing

Special Instructions to the Teacher

Simulator is for timing gear set-up which is basic in most farm tractors but a chain set-up can also be made. Punch marks could be removed, and require student to mark gears with a pencil to develop skill of checking for marks before removing.

Tools Needed

1. box-end wrench set
2. gear pullers

Supplies Needed

1. cleaning cloth
2. pencil if option is used

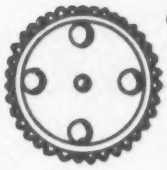
Simulator Materials

one engine block

Source of Materials for Simulator

1. farm equipment dealer
2. salvage yard
3. auto dealer

TOOLS/EQUIPMENT/SUPPLIES



CRANKSHAFT GEAR

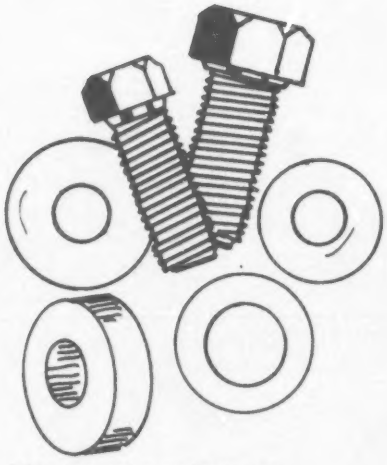
PENCIL

CAM GEAR

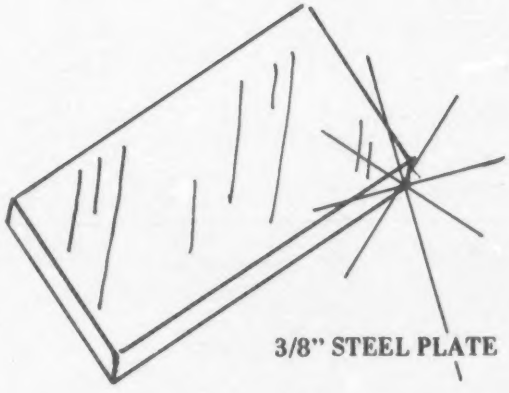
RAGS

INJECTOR PUMP GEAR

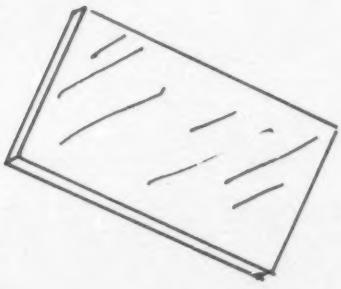
IDLER GEAR



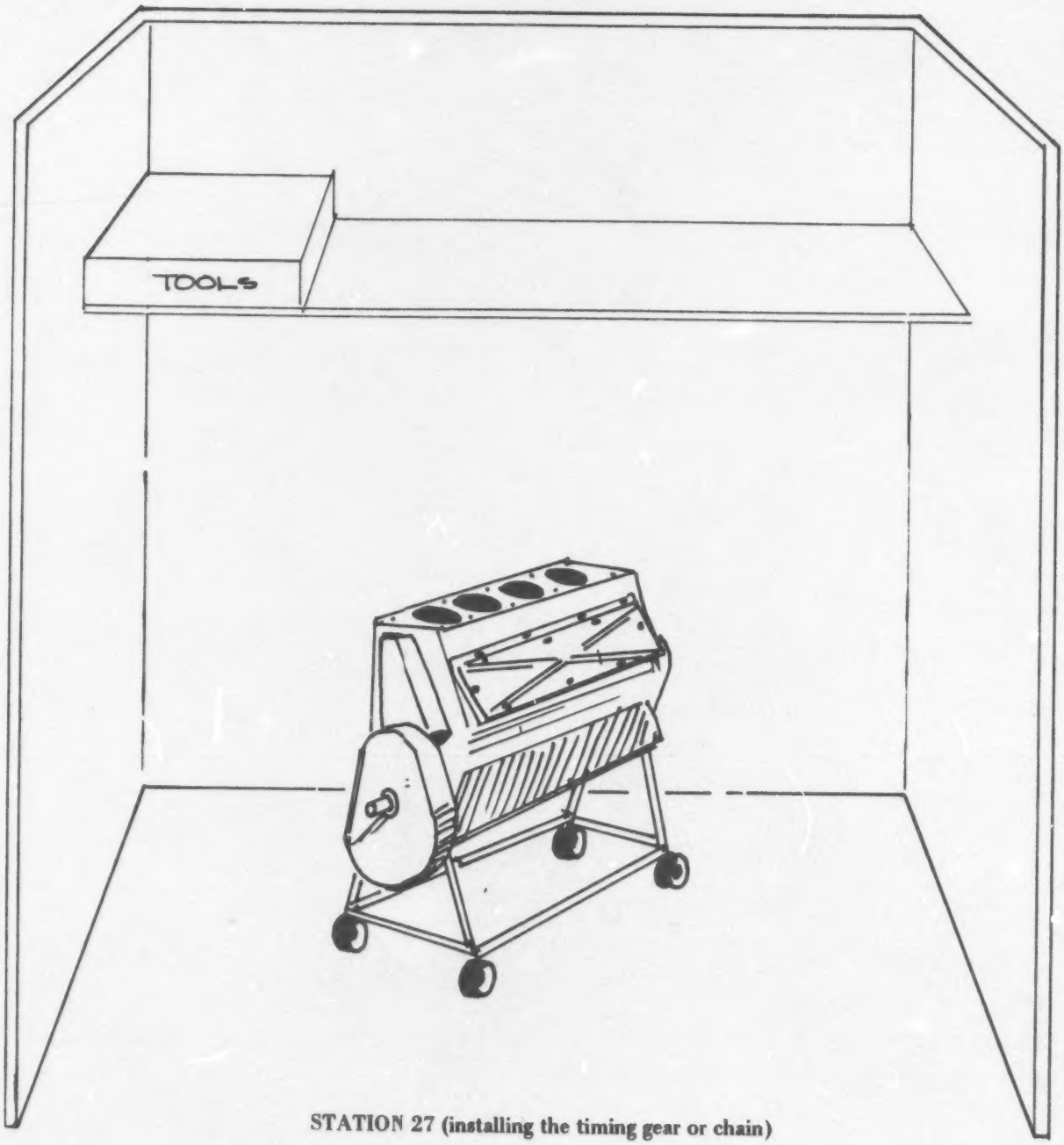
BOLTS AND BUSHINGS



3/8" STEEL PLATE



1/4" PLATE



STATION 27 (installing the timing gear or chain)

TRACTOR MECHANICS LEARNING STATION NO. 28

LEARNING ACTIVITY PACKAGE NO. 92

Changing Crankcase Oil and Filter

Description of Use

This kit can be used to enable the student to:

1. remove and replace a spin-on type filter
2. remove and replace a cartridge type filter

Special Instructions to the Teacher

With air pressure, 60 PSI, pressurize each filter. Take a 50-50 mixture of liquid soap and water and with a small artist brush, paint sealing points. If bubble occurs, oil leaks would occur.

Tools Needed

1. oil filter wrench
2. appropriate wrench to fit cartridge type element

Supplies Needed

1. cartridge type filter
2. spin-on filter

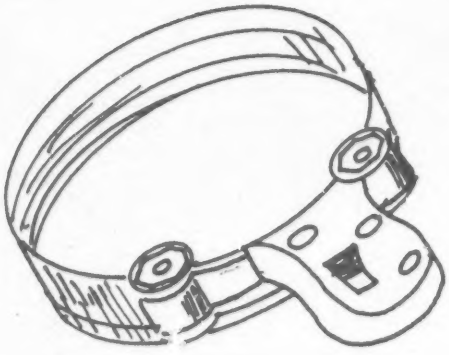
Simulator Materials

1. spin-on filter base for an engine (take arc welder and cut from engine block)
2. cartridge type filter housing
3. two valve stems
4. 1/4" x 12" x 12" plate steel for mounting
5. materials for box for housing

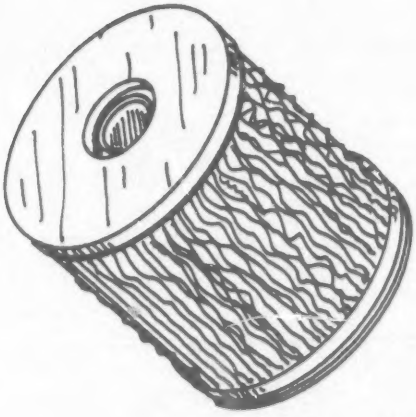
Source of Simulator Materials

1. salvage yard
2. auto supply store

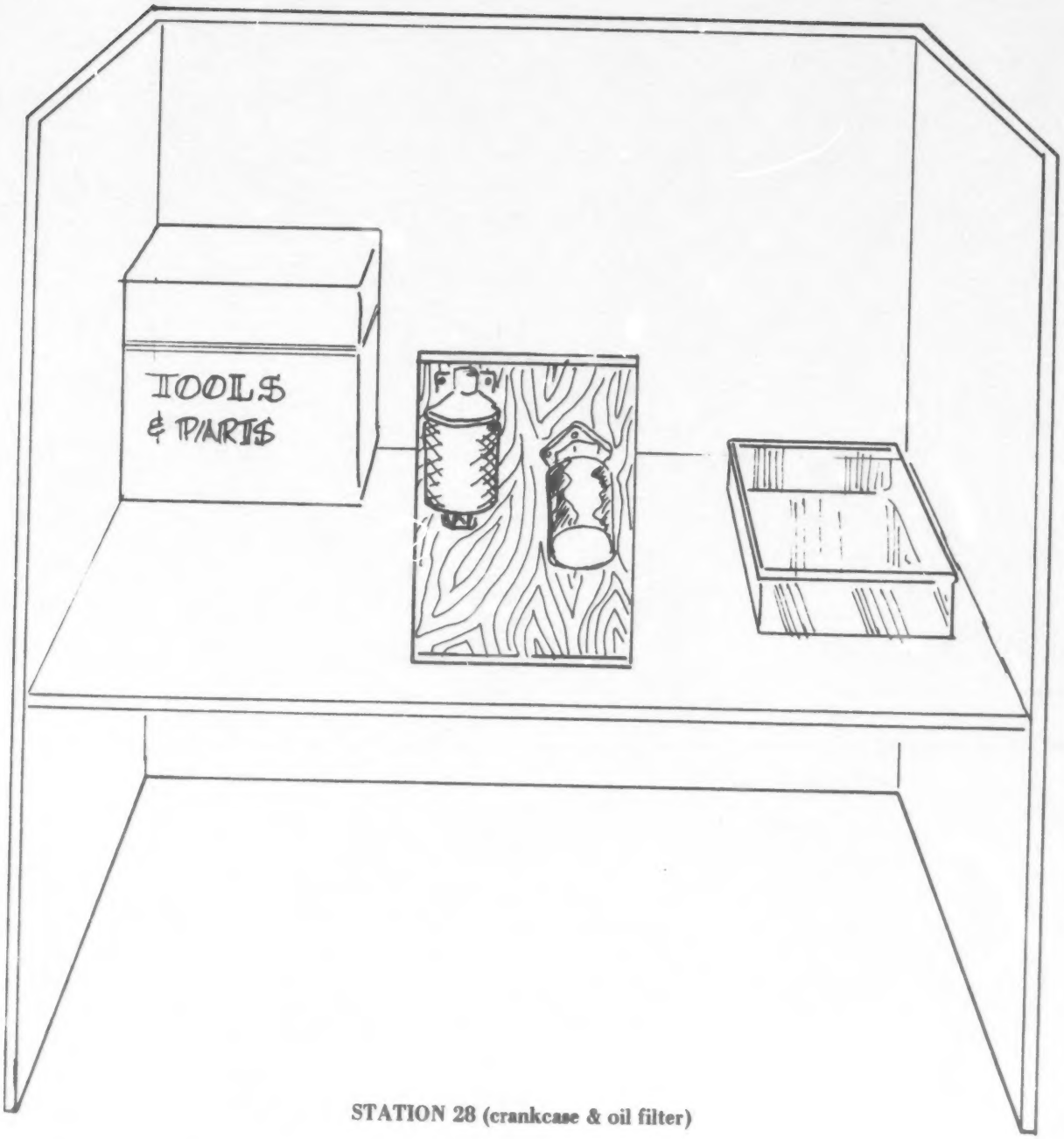
SPIN-ON FILTER



OIL FILTER WRENCH



CARTRIDGE TYPE FILTER



STATION 28 (crankcase & oil filter)

"END OF DOCUMENT"